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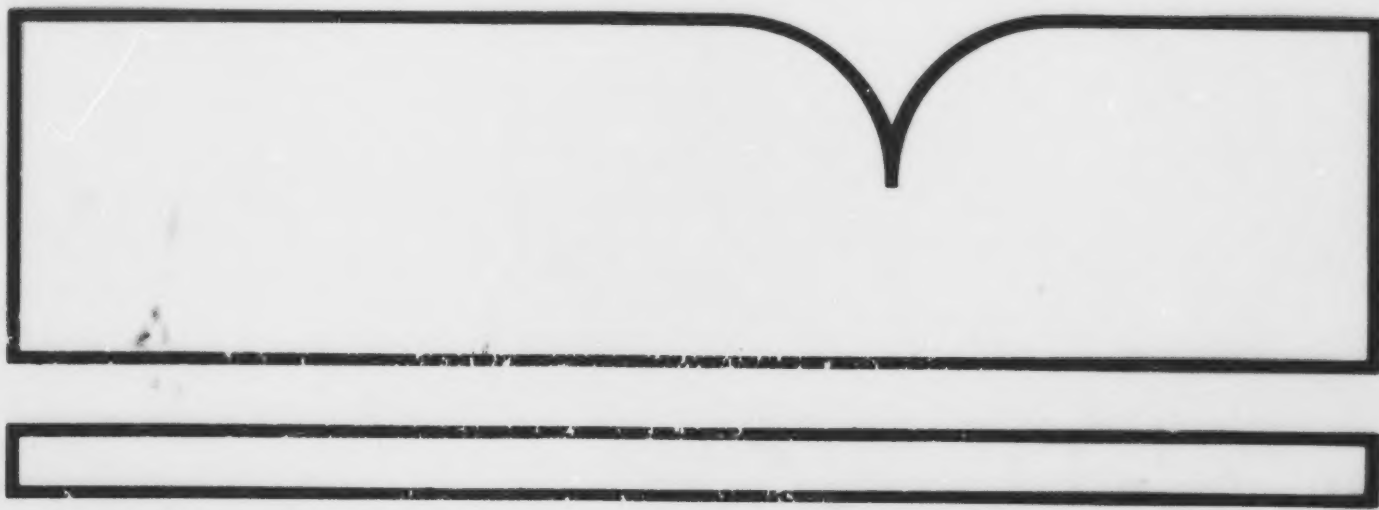
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Data

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FIELD VALIDATION OF EXPOSURE ASSESSMENT MODELS
VOLUME 1. DATA

by

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ABSTRACT

This is the first of two volumes describing work done to evaluate the PAL-DS model, a Gaussian diffusion code modified to account for dry deposition and settling. This first volume describes the experimental techniques employed to dispense, collect, and measure depositing (zinc sulfide) and nondepositing (sulfur hexafluoride) tracers. The measured concentrations of the tracers form a data set by which the PAL-DS model may be tested. These concentrations are given in tabular and graphic form for five downwind distances from the release point, ranging from 100 to 3200 m, and as a function of azimuthal angle. Measurements of wind speed, direction and temperature at seven heights from 1 to 61 m were taken during the tracer releases. These data are also included, along with evaluations of several parameters describing the turbulence characteristics. A discussion of particle size distributions of the depositing tracer is given, and the calibration and quality assurance procedures used for sample analysis are described. Two chlorocarbon tracers were also used in the tracer releases, but with little success. The first volume concludes with a discussion of the problems encountered with these tracers and some recommendations for possible solutions.

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Many of the techniques used for tracer collection and analysis in this study were based on years of research by the late Paul W. Nickola. His loss was felt frequently during the course of this work, and we continue to miss him.

SECTION 1

INTRODUCTION

This is the first of two volumes describing the work done on a project funded by the U.S. Environmental Protection Agency entitled "Field Validation of Exposure Assessment Models". The basic aim of this work was to release and sample tracers in the atmosphere, to obtain data suitable for an evaluation of the EPA PAL model as modified for depositing pollutants, and to perform such an evaluation. An additional goal was to make some limited releases of organic tracers and evaluate their measurement accuracy under controlled field conditions.

PAL is a Gaussian plume diffusion code for point, area, and line sources which has been modified by K.S. Rao (1981) to account for dry deposition and settling. The resulting PAL-DS code uses diffusion-deposition algorithms that are based on analytical solutions of a gradient-transfer model for dry deposition of gaseous and suspended particulate pollutants from a plume. In the limit when pollutant dry deposition and settling velocities are zero, these algorithms reduce to the standard Gaussian plume formulation.

In order to evaluate the PAL-DS model, three kinds of data are required: the distribution of some tracer subject to deposition to the surface, the distribution of some other tracer not subject to deposition, and the prevailing meteorology during the measurement periods. Zinc sulfide (ZnS) was chosen for the depositing tracer, while sulfur hexafluoride (SF_6) was used for the nondepositing tracer. Wind and temperature sensors mounted on several towers were used to assess the meteorological conditions during the tracer releases. Several organic tracers were also tried, but with little success.

This volume provides a description of the experimental techniques employed to dispense, collect, and measure the tracers used for the releases. It gives additional information on the characterization of the particle size distributions for the particulate tracer, the types of supporting meteorological measurements obtained, and the calibration procedures used for the tracer and meteorological measurements. Appendix A

is specifically concerned with various aspects of quality assurance in the collection and analysis of the data, but additional information of this kind is also provided in several other sections of the report. Finally, this volume of the report contains listings and figures describing the principal features of the measured tracer distributions and the winds and temperatures during the releases.

The second volume of this report contains a description of the approach used to evaluate the PAL-DS model and the motivation for the particular sampling strategy adopted for this study. It presents an analysis of the data that enables effective deposition velocities for the depositing tracer to be determined, and uses these and other estimates in an evaluation of the principal features of the PAL-DS model and three other models. It also presents a statistical summary of the performance of these models in simulating the observed behavior, gives some suggestions for interpreting this behavior, and recommends possible additional measurements and modeling studies that would further clarify the behavior of depositing materials.

SECTION 2

EXPERIMENTAL PROCEDURES

SITE CHARACTERISTICS

A detailed description of the Hanford diffusion grid, where the tracer measurements were obtained, is provided by Nickola (1977). The grid is located in a semiarid region of southeastern Washington on generally flat terrain. The vegetation consists primarily of desert grasses and 1 to 2 m high sagebrush.

Figure 1 is a schematic diagram of the diffusion grid and some of its principal features. Five sampling arcs, located at distances of 100, 200, 800, 1600, and 3200 m from the tracer release point, were used for tracer collection. A 122-m meteorological tower was located approximately 100 m to the north of the release area. It contained wind speed, wind direction and temperature sensors at 2.1-, 9.1-, 15.2-, 30.5-, 61-, 91- and 122-m elevations, and the information from these sensors was continuously displayed on strip charts in a building approximately 500 m to the west of the release point. These data were used to monitor conditions during tracer releases in an effort to ensure that material was released during periods with appropriate wind and stability conditions. Near-neutral to stable conditions were selected to maximize differences in concentrations of depositing and nondepositing tracers.

For subsequent, detailed analysis of the meteorology, data were collected at a second tower located in the center of the 1600-m arc. We felt that meteorological conditions there were likely to be more representative of the general conditions prevailing over the whole grid than those at the location of the 122-m tower. In addition, the 122-m tower is a rather massive structure, and some flow distortion in its vicinity is possible. The tower at the 1600 m arc was 61-m high, and was equipped with 3-component propeller anemometers and aspirated bead thermistors at heights of 1, 2, 4, 8, 16, 32 and 61 m. All anemometers were located on booms extending at least 2 tower diameters west (generally upwind) of the tower. Data from all sensors were recorded on 9-track magnetic tape approximately once every 2.3 s.

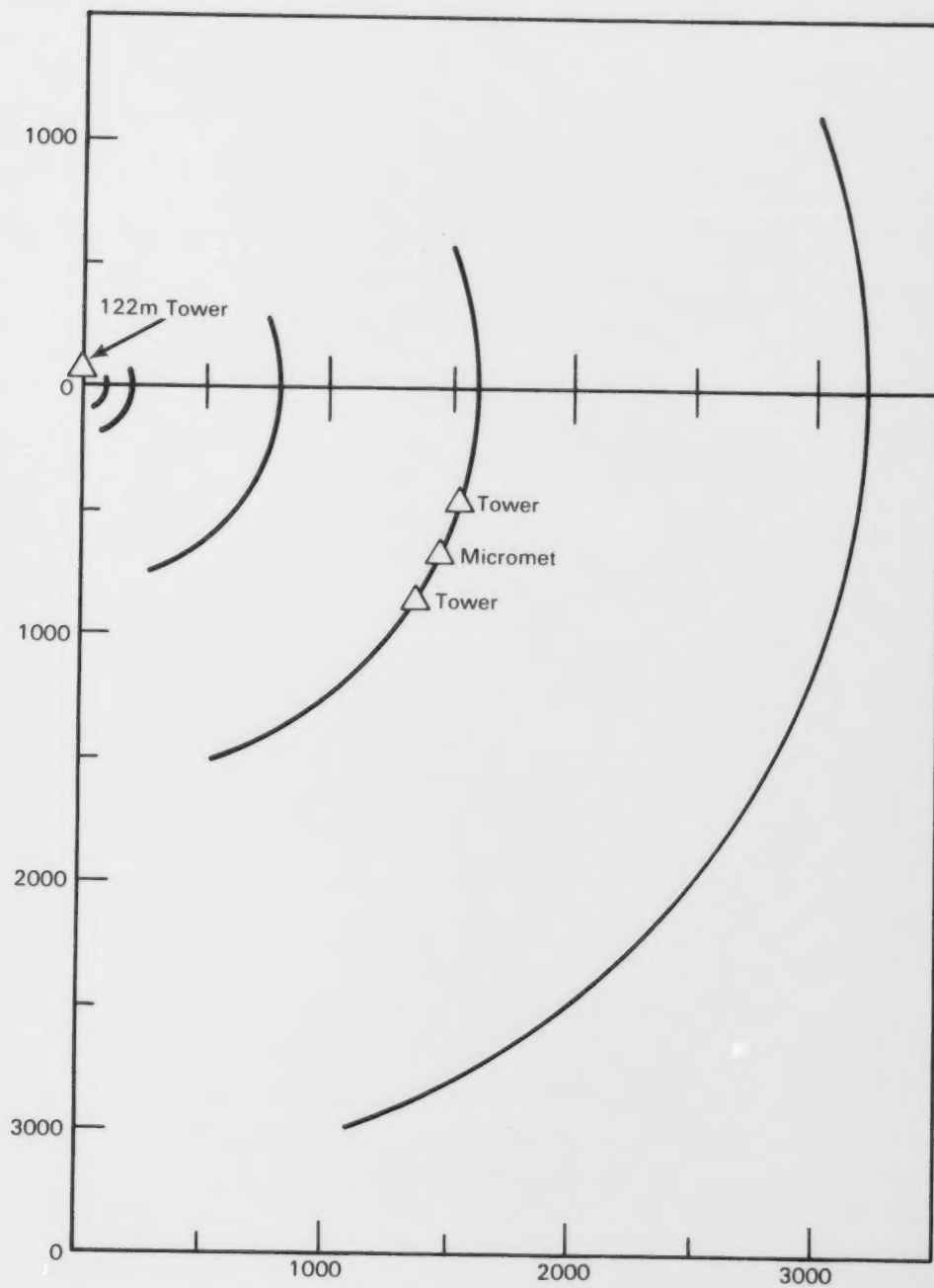


Figure 1. Schematic diagram of diffusion grid. Tracer release location is at origin; 61 m micrometeorological tower at 1600 m arc is at position labeled "MICROMET" and elevated samples were taken at positions labeled "TOWER". Distance scale is in meters.

A 3-m tower was located about 25 m to the southwest of the 61-m tower, and held a 3-component sonic anemometer and fast-response platinum resistance thermometer on a boom extending from its top. Data from these instruments were recorded at 10-16 Hz, but persistent malfunctions of two data collection systems used for these instruments limited the amount of useful data collected from them. Summaries of meteorological conditions during tracer releases are given in Appendix B, and some additional discussion is provided in Section 4.

The ZnS was collected on membrane filters mounted 1.5 m above the surface. The vacuum pumps used to draw air through the filters were driven with gasoline engines, and flow through the filters was regulated by critical flow orifices inserted just downstream of each filter holder assembly. Flow rates for all orifices were approximately $2 \times 10^{-4} \text{ m}^3/\text{s}$; details are provided in the tracer data summaries (Appendix C). Nickola (1977) provides a more complete description of the filter assemblies. Filters were located at 2° increments on the 100-, 200- and 800-m arcs, and at 1° increments on the 1600- and 3200-m arcs. Each arc encompassed a sector of approximately 90° .

The SF_6 and organic gaseous tracers were sampled using pulse pumps. The output of each pump was connected to an 18- ℓ polyethylene sampling bag; the input to each pump was through a 1.5-m length of polyethylene tubing with the opening mounted at a height of 1.5 m. At 25 selected locations, the polyethylene bags were replaced by 22- ℓ , 5-layer aluminized bags. The latter bags were considerably more expensive than the former and therefore were deployed only at this limited number of positions; they were used for both the SF_6 and organic tracer analyses. The polyethylene bag samples were not analyzed for organic tracers, since reactions with the bags caused a persistent decrease of apparent concentrations with time. Losses in the multilayer bags were small and provided no significant problems if the analyses were carried out within a few days of sample collection. There were other problems associated with sampling organic tracers, however, and these are discussed later in Appendix A.

The SF_6 tracer was sampled at intervals of 8° at the 100-m arc, 4° at the 200- and 800-m arcs, 2° at the 1600-m arc and 3° at the 3200-m arc. The multilayer bags were deployed at intervals of 12° at the 800-m and

3200-m arcs and 8° at the 1600-m arc. The pumping rate was nominally 100 cc/min, although variations by as much as a factor of two occurred among some of the pumps. This variation is not significant, since only the concentrations of tracer in the sampling bag and the total pumping time are needed for model evaluation.

Some effort was also made to measure vertical profiles of the tracer concentrations, and two towers at the 1600 m arc were equipped with filters and pumps to a height of 25 m. The towers were located at azimuths of 106 and 122 degrees, respectively, 8° to either side of the central tower used for the micrometeorological measurements. Twelve filters and seven pumps were placed on each of these towers, in addition to the samplers located at the 1.5-m level. The filters were located at heights of 0.2, 0.4, 0.8, 1.6, 3.1, 6.2, 9.3, 12.4, 15.5, 18.6, 21.7 and 24.8 m, while SF_6 samplers were placed at heights of 0.2, 0.4, 0.8, 3.1, 6.2, 12.4 and 24.8 m. For a variety of reasons, to be discussed later, the tower data were disappointing, and their utility is somewhat limited.

DISPENSING MECHANISMS

The ZnS particulate tracer was dispensed with a Metronics Model 5 Aerosol Generator[®]. The ZnS was mixed with 1%, by weight, Valron Estersil^(a) used as a fluidizing agent. The mixing was carried out for 15 min using a commercial paint mixer. Prior to tracer release, the mixture was loaded into a hopper on the generator. Material from the hopper was dropped, via a notched wheel, into a blower assembly, which ejected the particles horizontally into the atmosphere. During the release, the ZnS was continuously stirred to ensure smooth feeding of the particles into the blower. Feed rates varied between 0.44 and 0.48 g/s, except for one run with relatively strong winds, in which the rate was increased to 0.59 g/s. Release times were 30 minutes except for the release of June 24, 1983 [Julian date (JD) 175]; on that occasion

[®] Trademark of Metronics Associates, Inc., Palo Alto, California.

(a) E.I. duPont de Nemours and Co., Inc., Wilmington, Delaware.

a shift in wind direction led to the termination of the release after 22 min. The hopper was weighed before and after a release to determine the weight of released material.

The SF_6 was dispensed from a 91- ℓ tank that had been previously filled from a SF_6 cylinder to a pressure of approximately 1.4×10^6 Pa (200 lb/in²). The flow from the tank was regulated via a needle valve and rotometer, and the SF_6 was released through a length of polyethylene tubing. Typical release rates were on the order of 0.3 g/s. The amount of SF_6 released was found by comparing the weight of the tank before and after the release.

The organic tracers were released using a pressurized tank and generating gun assembly. The gun consisted of an outer aluminum tube, two ultrasonic nozzles, and a perforated tube behind the nozzles that provided a sheath of air isolating the organic material from the outer tube. The outer tube was heated with four 1200-W band-type heaters to prevent condensation of the tracer. A generator monitor and control unit allowed the pressure in the holding tank and the flow rates through the nozzles to be regulated as desired during a release. The holding tank was a standard commercial paint tank with a capacity of about 35 ℓ . Two 1500-W band heaters were installed around the outside of the tank and a blanket of fiberglass insulation wrapped around these. Pressure for the system was provided with a commercial air compressor. A typical release rate of organic tracer was 6.5 g/s.

All tracers were released from a height of 2 m. The separation between the SF_6 and ZnS release points was less than 1 m, while the distance between the ZnS and organic tracer release points was about 5 m.

SAMPLER DEPLOYMENT AND COLLECTION

Prior to release, a set of new filters and polyethylene sampling bags were labeled to indicate the sampling arc and azimuth at which they were to be deployed. Some of the multilayer bags were used more than once, because of their cost, but only after they had been thoroughly flushed and pumped out several times.

The bag samplers were connected to the output lines of the sampling pumps immediately before or up to several hours before actual tracer release, depending on availability of personnel. Approximately 1/2 hour before the intended tracer release time, the SF₆ and organic tracer sampling pumps were turned on manually. A radio-controlled system for switching these pumps on remotely was found to be unreliable, and the manual mode was adopted following the releases on May 18, 1983 (JD138). The turn-on time for each of these pumps was recorded. Approximately 1 to 1-1/2 h before tracer release, the filters were inserted into the sampling ports on the arcs, their protective caps were removed, and the vacuum pumps were activated.

At the conclusion of the tracer release, when the plume was judged to have cleared the various sampling arcs, a crew was deployed to turn off the SF₆ and organic tracer sampling units, close the valves on the sampling bags, and collect the bags and filters. The time at which each gaseous tracer sampling pump was shut off was recorded so that the total pumping time could be determined. The filters were covered with a dust cap and removed from the sampling ports. Filters and bags were returned to a central location where they were then stored until they could be analyzed.

SECTION 3

DATA REDUCTION

PARTICLE SIZING

An ideal particulate tracer for this measurement program would be mono-dispersed, i.e., all dispensed particles would be the same size. The size would be well known, large enough to provide significant deposition within a few kilometers of the source, small enough so that nonisokinetic effects (see Sample Analysis section) would be negligible, and easily, quickly, and inexpensively analyzed. A tracer meeting all these requirements was not available, and a compromise was necessary. We chose to use ZnS as the particulate tracer, based on its relative ease of analysis, past experience with its use in many other tracer studies, its ease of preparation and dispensing, and the knowledge that it did show significant depletion from deposition. Its principal drawback was its polydisperse nature.

The ZnS tracer is Helecon Fluorescent Pigment 2210[®]. A number of attempts to obtain particle size distributions of this material have been made, and it is instructive to compare the results. A convenient mode of comparison is provided by assuming that the mass size distribution is described by a log-normal curve, which is defined in terms of its mass median diameter, d , and the standard deviation of the logarithms of the particle diameters about the mean, σ_g . Nickola (1977) quotes values of 4.1 μm and 1.6, respectively for these two quantities; this pair of values may be denoted by (4.1, 1.6). The determination was made by optical microscopy. Sehmel (1966) also provided a size distribution for ZnS, from which one can estimate values of 8, 2.4).

For this investigation, three different methods of particle sizing were tried. The first method used an impactor located about 25 m downstream from the aerosol generator to sample the dispersed tracer. Values for d and σ_g of 3.0 μm and 2.0, respectively, were obtained. A

[®] Trademark of the U.S. Radium Corporation, Morristown, New Jersey.

second determination of particle size distribution was made using a Sedigraph[®], a device that measures the sedimentation rate of particles in solution, using a collimated beam of x-rays to determine the concentration of particles remaining at various sedimentation depths as a function of time. This method gave the largest mass median diameter and spread of the three methods that we tried, viz., (7.1, 2.8). Finally, filters were exposed to the particles emitted from the aerosol dispenser and photographed with an electron microscope. The photographs were analyzed with a computer-aided scanning and counting apparatus. Three filters were analyzed, yielding values of (4.25, 1.8), (6.0, 1.7), and (4.8, 1.8).

We are unable to offer a satisfactory explanation for the spread in values that were obtained, except to note that particle sizing is a difficult art. It is also interesting to note that the three electron microscope sizings ordered with the distance between the source and the filter. The highest mean value of particle size was obtained when a filter and the dispenser were located about one meter apart in a closed room. (This method is not recommended for those wishing to remain free of ZnS dust.) The middle value was obtained with the filter located about 4 m from the source; the smallest value was found on a filter about 25 m from the source. The "systematic" decrease in size may result from a depletion of the largest particles with increasing travel distance, but this is only speculative.

The principal consequence of this uncertainty is that it is impossible to predict the rate of deposition of this material, since that rate depends, *inter alia*, on the mass distribution. An approach that effectively bypasses this obstacle is described in detail in the second report of this series. For experimental design purposes, values of $d = 4.8 \mu\text{m}$ and $\sigma_g = 1.8$ were chosen, which lie in the midrange of the values given above.

[®] Trademark of Micromeritics Instrument Corporation, Norcross, Georgia.

SAMPLE ANALYSIS

Concentrations of ZnS on the filters were determined by using a device developed at Hanford by M.O. Rankin and known as a Rankin counter. Its essential elements consist of a weak plutonium source of alpha particles, which are used to induce fluorescence in the ZnS particles, a photomultiplier tube used to detect this fluorescence, and a scaler used to count light flashes. The number of such flashes depends on the concentration of ZnS present and the voltage settings for the scaler and photomultiplier. A standard filter is periodically checked to guard against the possibility of drift in the calibration. Nickola (1977) provides additional details on this device.

Nickola (1977) also quotes a calibration constant of 2.06×10^{-10} g of ZnS per count recorded by the Rankin counter. As a further check on this value, a number of filters were exposed to ZnS during releases in the fall of 1982, measured by the Rankin counter, and then analyzed with x-ray fluorescence for total zinc. Some scatter was encountered in the data, particularly at low concentrations where the presence of background zinc in the filters themselves was comparable to or greater than the Zn deposited there from the ZnS tracer. Accordingly, the determination of the calibration factor was made using 18 filters having Rankin counts of 5000 or more. (For comparison, typical maximum values of Rankin counts at the 100-, 800- and 3200-m arcs were on the order of 1×10^6 , 30,000 and 2500, respectively.) A plot of the ratio of the areal density of Zn, determined from the x-ray fluorescence, to the number of Rankin counts is shown in Figure 2. Based on these values, a calibration factor of $2.05 \pm 0.50 \times 10^{-10}$ gm of ZnS per Rankin count was found. Although the uncertainty in the calibration factor was larger than one might wish, the mean value is remarkably close to the value obtained by Nickola (1977) using a completely different set of filters.

A particularly troublesome aspect of the use of particulate tracers is the effect of nonisokinetic sampling. This effect arises when particle inertia causes the particle trajectories to deviate from the streamlines of

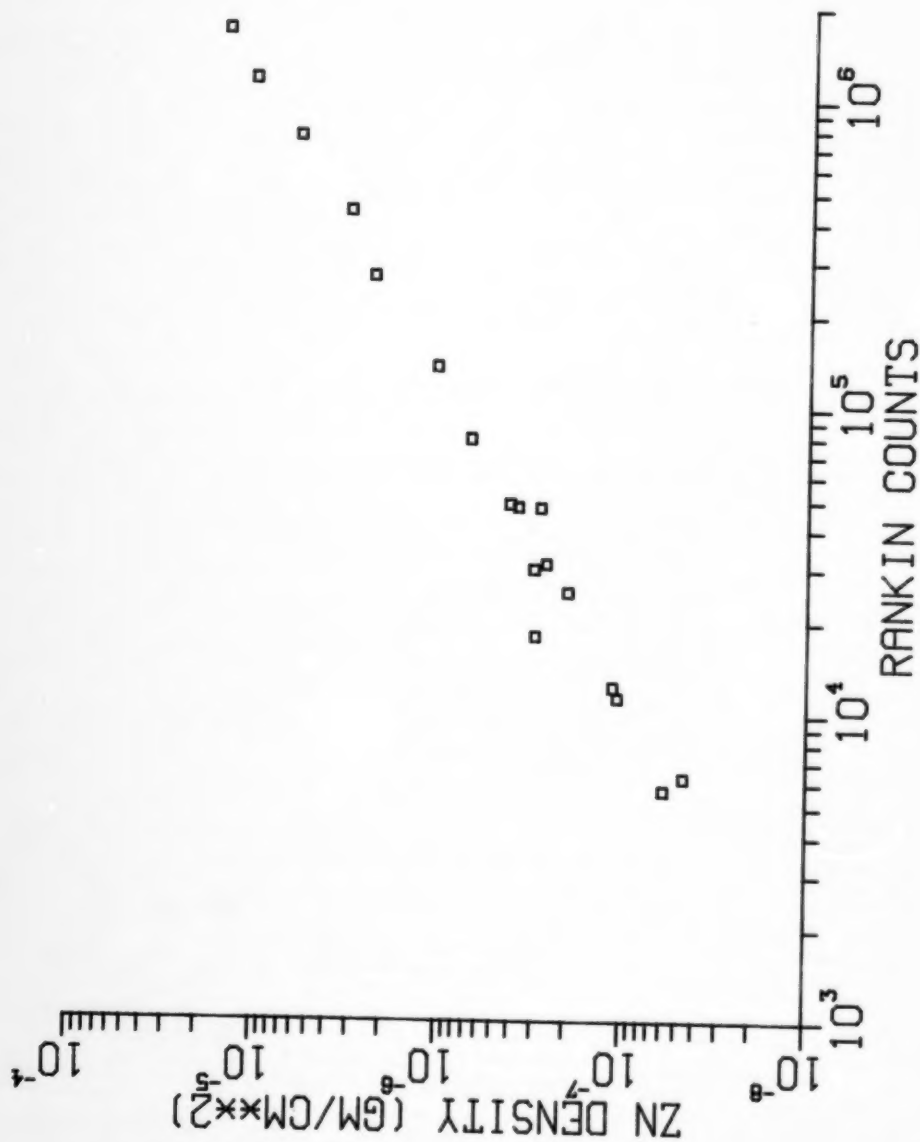


Figure 2. Rankin counter calibration results using x-ray fluorescence.

the airflow. For subisokinetic sampling, i.e., when the inlet speed of a filter is less than the free stream wind speed, the number of particles impinging on the face of the filter will be larger than the number passing through a stream tube corresponding to the filter diameter. This effect increases as the particle size increases and must be taken into account when interpreting the results deduced from measurements of total particle mass on a filter.

In order to assess the magnitude of this problem, it is necessary to know either the particle size distribution of the released tracer or of the tracer collected on the filter; neither of these is known with certainty. In addition, the behavior of the filter configuration used for various particle sizes, pumping speeds, and ambient winds must be known. Information of this kind is rather limited, although Sehmel (1966) has obtained some empirical descriptions of such behavior for the filters used in these experiments. Given an assumed size distribution for the ZnS particles, he was then able to estimate correction factors to be applied to the measured mass of ZnS found on a filter. The nonisokinetic correction factors used for the releases described here were derived from Sehmel's work. There are a number of uncertainties in these correction factors, and some of the reasons for these uncertainties are discussed in detail in Sehmel's article. The actual values used are given in the data listings in Appendix C.

The SF₆ and organic samples were analyzed by means of gas chromatography, using a Hewlett Packard Model 5736^(a) for the organic tracers and a Systems, Science and Software Model 215AUP^(b) for the SF₆. Calibrations of these instruments were obtained using National Bureau of Standards (NBS) traceable standards. The background detection limit for SF₆ was approximately 15 parts per trillion (ppt), and for the organic tracers it was about 0.1 parts per billion (ppb). Levels below these values were assumed to be due to background signals alone, and were not included in the data analysis. Additional details are given in Appendix A.

(a) Hewlett-Packard, Inc., Avondale, Pennsylvania.

(b) Systems, Science and Software, LaJolla, California.

The results of the tracer analyses are presented in Appendix C in tabular form. For the ZnS, the number of Rankin counts is given for each azimuth at which a significant value of ZnS was detected. The normalized exposure value is also given. This value is obtained by converting the Rankin counts to equivalent mass of ZnS on the filter, dividing by the flow rate through the filter, scaling by the nonisokinetic correction factor, and dividing by the total amount of ZnS released. For the SF₆, the concentration in each sampling bag is given in ppt. The concentration is multiplied by the total pumping time, also given, multiplied by a scaling factor to convert ppt to weight, and divided by the amount of SF₆ released. A similar listing is given for the organic tracers, except that concentrations are given in ppb. Amounts of tracer released, flow rates through filters and nonisokinetic correction factors are also listed where relevant.

The ZnS concentrations for the towers are not corrected for nonisokinetic effects. The difficulty is that the correction factors become larger for the higher wind speeds found at greater elevations, and the potential for error becomes much greater. This difficulty is compounded by the fact that we expect the mass distribution to change significantly with height, resulting in even greater uncertainty. Moreover, filters located very close to the surface may be partially shielded by nearby grass or sagebrush, and any interpretation of these data would be rather uncertain. For these reasons the tower data are of limited use.

METEOROLOGICAL DATA

Appendix B provides summaries of the meteorological data obtained from the instrumentation at the 1600 m arc. Mean wind speeds, directions and temperatures are given during the release period and for an equal period after the releases so that one may obtain an idea of the stationarity of the conditions. As might be expected under stable conditions with low wind speeds, shifts in speed and direction were common, and the decision on the time to release tracers was made partially on the basis of an educated guess.

Appendix B also contains information on the standard deviations of the horizontal and vertical wind direction fluctuations, determined from the propeller anemometers. For a steady wind direction, the horizontal standard deviation is useful for predictions of the lateral plume spread, while the vertical standard deviation may be related to the vertical plume spread. For each release period we have included a histogram of the wind direction at the 2-m level, where a "count" in the histogram represents a direction value obtained at intervals of 2.3 s.

We have also included time series of the 2 m wind speeds and directions so that systematic trends, during and after the release period, can be identified. In addition, profiles of the wind speeds and temperatures in the first 61 m of the atmosphere are plotted.

Wind speeds from a three component sonic anemometer and temperatures from a fast-response platinum resistance probe were recorded during parts or all of four of the releases. From these data we determined values of the friction velocity u_* , temperature flux $w'T'$, and the Monin-Obukhov length L . In all, six periods ranging from 20 to 30 min were analyzed to determine these quantities. The results are summarized in Table 1, along with other estimates of u_* and L determined by the methods described in the following paragraphs. In the determination of the correlations used in quantities such as u_* , the u , v , w and T time series were first filtered, the mean value and any linear trend were removed, and the correlations, e.g., $u'w'$, subsequently calculated.

TABLE 1. COMPARISON OF SONIC AND PROFILE ESTIMATES OF u_* AND L

<u>Period</u>	<u>Time</u>	<u>u_* (cm/s)</u>		<u>L (m)</u>	
		<u>Sonic</u>	<u>Profile</u>	<u>Sonic</u>	<u>Profile</u>
138S	22:47-23:13	40	48	166	196
146S	23:24-23:44	26	18	44	29
175E	22:42-23:04	26	24	60	63
175A	23:04-23:26	19	17	26	45
178A	21:31-22:01	26	21	59	109
178B	22:01-22:31	30	25	71	91

While the temperature data seemed quite "clean", it was evident that the sonic data were contaminated by a certain amount of noise, so a digital filtering procedure was applied. Each data series was examined for sudden jumps in the recorded voltage levels. If a jump of 150 mV or more (corresponding to approximately 1.5 m/s) occurred between adjacent scans (either 0.1 or 0.067 s apart, depending on the data recording system), the subsequent voltage values were linearly interpolated until the voltage level returned to within 1.5 standard deviations of the running mean value of the sonic signal. The running mean was calculated recursively with the expression $m' = m + (1-\lambda)s$, where m is the old mean, s is the new signal value and λ was set equal to 0.993. For a unit step function signal, the mean will rise from 0.0 to 0.5 in 99 steps with this filter. The running variance was defined in a similar fashion, and the standard deviation determined from the square root of the variance.

In general, only a few percent or less of the data points were affected by this procedure, but for the data during the release period on June 24, 1983, over 11% of the v -component values required adjustment. This resulted in a 51% reduction in the standard deviation of the horizontal wind fluctuations, σ_v , but only an 8% reduction in u_* and a 5% increase in $\overline{w'T'}$, calculated from the unfiltered data. Hence, while significant noise was present in the sonic signals, it was generally uncorrelated and did not seriously affect flux estimates.

A number of checks of the reasonableness of these values were made. Hicks (1981) has summarized the current knowledge of the behavior of turbulent fluctuations in a stable atmosphere. He suggests that σ_w/u_* should approach a value between 1.3 and 1.4, where σ_w is the standard deviation of the turbulent vertical velocity component. Our values range from 1.15 to 1.56, with an average value of 1.29 and a standard deviation of 0.15. Hicks (1981) shows values of the ratios σ_u/u_* and σ_v/u_* of about 2.2 and 1.7, respectively. Our corresponding values are 2.5 and 2.0. Conditions during our flux measurements were less than ideal, with non-stationary meteorology, a vegetation cover that resulted in a significant displacement height and slight irregularities in the terrain. In view of these limitations and the necessity of applying a digital filter to our data, the agreement of our sonic data with "standard" behavior is quite good.

The situation is not as satisfactory for the temperature fluctuations. Hicks (1981) notes that σ_T/T_* rises to approximately 1.85 in stable conditions, where $T_* = \overline{w'T'}/u_*$. In contrast, we found this ratio to be 2.57 ± 0.53 , or about 37% higher. We note, however, that Beljaars, Schotanus and Nieuwstadt (1983) report values of σ_T/T_* near 3.5 in the near neutral case. Examination of selected cospectra of w' and T' revealed rather noisy behavior. The heat fluxes themselves were small, and these factors contributed to our uncertainty. The result is that there is some doubt on the accuracy of the determination of L from these data.

A second means of obtaining flux information is through an analysis of the mean wind and temperature profiles. Previous investigation (Horst and Elderkin, 1970) of the momentum flux/wind profile relationship at the 1600-m arc of the Hanford diffusion grid showed the need to subtract a height D from the heights of the profile measurements in order to account for the upward displacement of the flow by the sagebrush "canopy". The best fit of this earlier data was given by a displacement height of 1.4 m and a roughness length z_0 of 3 cm. A similar analysis was performed with the current data set, using six periods during which flux data were taken from the sonic anemometer. The best agreement between the directly measured and profile-derived values of u_* was given by either $D = 1.3$ m and $z_0 = 4.5$ cm or $D = 1.4$ m and $z_0 = 3$ cm. The root mean square difference between the sonic and profile estimates of u_* was approximately 5.6 cm/sec in either case.

A similar analysis was also made for the temperature profiles, in order to estimate the heat flux and the Monin-Obukhov length L . Unfortunately, these profile-derived values of L agreed poorly with those calculated from the direct flux measurements. This is not surprising because the measurements show that the temperature profiles are much more irregular than the wind profiles, a situation that is not unexpected during stable atmospheric conditions. In addition, since it is necessary to use both the wind and temperature profiles in the estimation of the heat flux and L , departures of either profile from the expected functional form will contribute errors to the estimation of these parameters.

A more satisfactory profile estimate of L was obtained from the linear term of the log-linear wind profile,

$$u(z) = (u_*/k) \{ \ln[(z-D)/z_0] + 5(z-D)/L \} \quad (1)$$

The best agreement between the directly measured and profile-derived values of L was given by $D = 1.5$ m and $z_0 = 2$ cm, with the rms difference between the sonic and profile estimates of L equal to about 17 m.

Based on these results for estimating u_* and L from the wind and temperature profiles and the earlier analysis at the same site, values of $D = 1.4$ m and $z_0 = 3$ cm were chosen for all analyses of the profile data. Table 1 lists the resulting, profile-derived values of u_* and L along with the directly measured values for the six periods for which sonic data were taken. The rms difference between the sonic and profile estimates is 5.6 cm/s for u_* and 27 m for L.

In Appendix B we have summarized our best estimates for values of u_* and L for the release periods and have indicated the type of analysis used for their determination.

SECTION 4

GENERAL CHARACTERISTICS OF INDIVIDUAL TRACER RELEASES

This section contains a brief, narrative description of selected features of each of the six tracer experiments conducted during this study. The prevailing meteorology during the release period, the performance of the sampling equipment and some general descriptions of the resulting tracer distributions are given.

May 18, 1983 (JD138), 22:48-23:18. Wind speeds during the release were the highest of the six runs, averaging over 3.5 m/s at 2 m. At that height they decreased somewhat during the course of the release. The temperature inversion was very weak, giving only slightly stable or nearly neutral conditions. The wind direction was quite favorable and steady, resulting in narrow plumes, well-contained by the sampling arcs.

The ZnS sampling units generally performed well, with only minor losses of data from equipment failure. At the 3200 m arc, a weak vacuum on 3 of the filters may have resulted in some tracer loss, but only on the fringes of the plume. The SF₆ sampling system performed very poorly, with a large fraction of the sampling units failing to turn on or shut off on transmission of the appropriate radio signals. Amazingly enough, with the exception of one sample at 3200 m, there appeared to be no loss of data. The malfunctions were confined to areas outside the plume region, as shown by comparisons with the ZnS results. The temperature sensor at 4.0 m appears to have given an erroneous value.

May 26, 1983 (JD146), 23:24-23:54. Wind speeds during this run were light at the surface, but increased to over 8 m/s at 61 m. A temperature inversion of 1.5°C in the first 16 m resulted in stable conditions. There were bimodal distributions of ZnS at most arcs; this was seen in the SF₆ distributions as well. The tracer plumes were again well-contained at all arcs.

At 800 m, there was a sharp decrease in ZnS concentrations south of 124°, a feature also seen in the SF₆ results. An engine failure at 3200 m precluded a determination of the true ZnS concentrations at 113°

and 114°. The SF₆ system, operated manually in this and subsequent runs, performed reasonably well. A number of sampling bags, noted as "flat" or nearly flat, nevertheless gave quite reasonable values for sample concentrations. One exception occurred at 3200 m, where a flat bag at 86° yielded an unreasonably high value. An examination of the direction histogram showed no apparent cause for the bimodal nature of the tracer distributions. The 4.0 m temperature sensor again gave values of temperature that appeared to be in error by about 1 °C; it was replaced at the end of this run.

June 5, 1983 (JD156), 22:10-22:40. Surface winds were slightly higher during this run than during the previous one, but the winds at 61 m were slightly weaker. The winds generally decreased during and after the release, shifting to a more southerly direction. An inversion of 0.7 °C in the first 16 m again resulted in slightly stable conditions. The tracer results were perhaps the best of the 6 releases, with the plumes again being contained by all the sampling arcs. The engine driving the filter pumps at 113° and 114° at 3200 m again failed, but all other ZnS and SF₆ units functioned correctly.

June 12, 1983 (JD163), 22:43-23:13. Wind speeds were somewhat weaker than during the previous release, and an inversion of about 1.3 °C in the first 16 m was present. The wind direction showed a southerly trend during the release that became less pronounced toward the end. The SF₆ sampling was generally successful, but the ZnS sampling was not quite as good.

At 200 m, the filter at 106° was dirty and showed an anomalously low value. At the 800-m arc, ZnS concentrations north of 102° showed extremely low values, suggestive of a malfunctioning engine. The SF₆ values also decreased fairly rapidly there, so it appears that the peak of the ZnS distribution was captured but the north side was lost. The 1600-m ZnS concentrations showed some irregularities, with a particularly low value at 104°, but we have no ready explanation for this. At 3200 m, it appears that the filters at 104°, 105° and 106° also had low values, again presumably arising from a malfunctioning engine. At 3200 m, a flat bag at 111° made it impossible to determine the true position of the peak SF₆ concentration.

June 24, 1983 (JD175), 23:06-23:28. This release had the lightest near-surface winds of the 6 cases described here. The inversion in the first 16 meters was just over 1°C at the beginning of the release, and increased to about 2°C by the end. The wind direction shifted during the run, eventually forcing a termination of the release after only 22 min. The plumes were blown toward the north end of the sampling arcs and were not generally contained.

The problem of unfavorable wind directions was exacerbated by engine failures at the north ends of the 100 and 1600 m arcs, and apparently the 800-m arc as well. The SF₆ samplers performed much better. However, at the 800 m arc there was an odd increase in SF₆ concentration at 68°, a result that must be regarded with suspicion.

June 27, 1983 (JD178), 21:31-22:01. Winds were somewhat stronger for this run, averaging about 1.5 m/s at release height during the release. They increased during and after the release, and shifted to a more southerly direction. Observers at the release point noted a number of large swings in wind direction, and this was apparent in the histogram of directions as well. The inversion in the first 16 meters weakened from about 1.7 °C in the 30 min before the release to 1 °C in the 30 min after. The ZnS distributions were irregular and suffered from some significant data loss; the SF₆ results were generally acceptable.

Engine failures at the north end of the 100-m arc effectively prevented the sampling of about half of the ZnS plume. The 200-, 1600- and 3200-m ZnS concentrations showed rather irregular behavior, compounded by the presence of several dirty filters. At 800 m, the filter at 124° showed an anomalously high spike in the ZnS values, but we have found no explanation for this. A number of pump failures at the 1600-m and 3200-m arcs resulted in lost SF₆ data there, but we feel that reasonable interpolations for the missing values can be made.

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APPENDIX A

QUALITY CONTROL

The quality control procedures pertinent to this work have been described extensively in a document prepared for this project entitled "Field Validation of Exposure Assessment Models, QA Project Plan for an EPA Extramural Project", Revision 2 and dated May 3, 1983. In this appendix we present additional information on how well various objectives were met, problems that were encountered, and some possible consequences of these problems.

METEOROLOGICAL MEASUREMENTS

Collection of data from the propeller anemometers and the aspirated thermistors was generally good, although 100% completeness was not obtained. The w component at 61 m was not recovered, and the w arm of the anemometer at 1 m was deliberately not connected. These caused no problems since w at 61 m is of little interest, and at 1 m the propeller anemometer's response is inadequate to measure w fluctuations properly. The w component at 4 m seems to have been lost starting with the June 12, 1983 run, and there was an alignment problem at 8 m during the first two runs. Hence, the w data are not as good as one might wish, but this is of relatively minor importance. At 2 m the w data looked satisfactory, and these are the data most likely to be used in flux computations. If the other levels are to be used, we recommend that a coordinate rotation be used to ensure that the mean w value at each level is zero. Note, however, that comparisons of momentum flux values obtained from the sonic anemometer with those obtained from the 2 m propeller anemometer are not good. The values of u_* computed from the latter data were always lower than the values of u_* obtained either from the sonic data or from an analysis of the wind profiles. This result is also not surprising, since this kind of propeller anemometer cannot be expected to respond to all the important vertical fluctuations under the meteorological conditions encountered. For flux estimates it is advisable to rely on the sonic anemometry results or the profile derived values; a discussion of these was given in Section 3.

In all cases, the u and v components of the anemometers appear to have given reliable results. As noted in the quality assurance document for this project, consistency and "reasonableness" of the velocity profiles is often the best test for such reliability, and wind profiles were good in this regard.

The thermistors used for temperature measurements were originally calibrated in a constant temperature bath, and a least squares fit was deduced relating their temperature to the voltage measured in a Wheatstone bridge with the thermistor serving as one arm of the bridge. After the field measurements were completed, a second calibration was carried out, and the temperatures calculated from the least squares fits were compared to the bath temperatures and to each other. On the basis of this second calibration, empirical corrections were applied to the original calibration curves to improve the relative calibrations of the thermistors. These corrections were 0.1 °C or less in all cases. The tabulated values reflect all such adjustments. Absolute temperatures should then be accurate to better than 0.3 °C, while temperature differences between levels should be good to approximately 0.1 °C. Both of these figures exceed the original stated objectives. Even so, an examination of the temperature profiles reveals kinks in several of the runs that suggest further adjustments might be considered. However, as we have no basis for such adjustments, we have left the profiles as they are. As noted earlier, the 4-m thermistor gave unreasonable values during the first two releases and was replaced. With this exception, data recovery was complete.

Malfunctions in the data collection system for the sonic anemometer resulted in some data loss for the first two releases. During the first release, fast-response data were collected for 25 min, while 20 min of data were obtained during the second release. Each release lasted 30 min. During the next two runs, no fast response data were obtained. A new data acquisition system was installed and debugged in time to obtain complete data sets for the last two releases. A discussion of some of the analysis procedures for these data is given in Section 3.

For the propeller anemometer and thermistor results, missing or clearly erroneous data are entered as 999 in the tabulations. Fortunately, the data recovery from the instrumented 61 m tower was quite good, and few problems are anticipated in this area.

TRACER SAMPLER RECOVERY

For a variety of reasons, data of one form or another may not be available for a particular release. The most common reason for missing tracer data was the failure of a pump or gasoline engine to operate properly. In the case of the ZnS, an engine malfunction could disable up to seven sampling stations, since one engine was used for a number of filters. Occasionally, a filter would be observed to have a significant quantity of dirt on it, and this makes the ZnS count suspect. For the SF₆ and organic tracer analysis, most "missing" samples resulted from flat bags caused by a failure of the sampling pump. In a few instances, a flat or nearly flat bag still yielded a measurable tracer concentration. These conditions are noted in the tabulation of the data in Appendix C, and no adjustments of the data have been made there.

Statistics on the completeness of the data recovery for tracer samples are apt to be misleading unless examined in some detail. For example, if 95% of the filter samples on an arc are recovered, but 80% are outside the plume and the missing 5% are at the plume center, the recovery figures would look good, but the data might be of little value. A more meaningful figure may be obtained from an estimate of how many samples fell within the tracer plume and what fraction of these were recovered. Even this figure is somewhat arbitrary since the cut-off value for values "within the tracer plume" is not well-defined. For arcs close to the source it is certainly unnecessary to sample filters whose concentrations are near background levels, since the peak concentrations may be four or five orders of magnitude higher. On the other hand, for the more distant arcs only a few samplers may show above background concentrations. With these caveats in mind, see Table A-1, which gives the fraction of ZnS and SF₆ samples "recovered" at each arc. The recovery rate is based on estimates of the width of the plume and the reliability of the data, as well as the number of samples actually collected. These values should be read in conjunction

with the descriptions of the General Characteristics of Individual Tracer Releases (Section 4) as well as with the graphical depictions of the data in Appendix C.

TABLE A-1. FRACTIONAL DATA RECOVERY VALUES FOR TRACER RELEASES

Release Date/Arc	100 m	200 m	800 m	1600 m	3200 m
5/18 83 ZnS	1.00	1.00	1.00	1.00	0.82
JD138 SF6	1.00	1.00	1.00	1.00	0.75
5/26/83 ZnS	1.00	1.00	1.00	1.00	1.00
JD146 SF6	0.90	0.89	1.00	1.00	0.95
6/5/83 ZnS	1.00	1.00	1.00	1.00	0.83
JD156 SF6	1.00	1.00	1.00	1.00	1.00
6/12/83 ZnS	1.00	0.95	0.65	1.00	0.84
JD163 SF6	1.00	1.00	1.00	1.00	0.86
6/24/83 ZnS	0.70	1.00	0.64	0.71	0.97
JD175 SF6	1.00	1.00	0.92	0.95	0.91
6/27/83 ZnS	0.60	0.91	0.94	0.90	1.00
JD178 SF6	1.00	1.00	1.00	0.86	0.92

Appendix C contains a graphical representation of the tracer exposures for all arcs in all the runs for which both SF₆ and ZnS data are available. In several cases, interpolations of data were made to produce a smoother and more reasonable curve. For example, if an SF₆ sampler bag was flat, a value somewhere between the two adjacent sample values might be used, rather than assigning an exposure of zero to the flat bag. In one case (June 27, 1983, 800 m arc, azimuth 124°) a ZnS point has been interpolated rather than accepting an anomalously high value that is grossly inconsistent with the observed SF₆ pattern. In several other cases, interpolations have been made where dirty filters cast doubt on the accuracy of the readings. All such points are clearly indicated on the graphs.

It is evident from Table A-1 that we were more successful in defining the plume in the earlier runs than in the later ones, and that the recovery rate for SF₆ was generally better than for ZnS. Both of these features

arise from the extreme difficulty we experienced in keeping a supply of properly operating gasoline engines on hand. The engines were old and in poor shape when this program began, and considerable time and money was invested in restoring them to working condition. Keeping a sufficient number of them operational was a continuing struggle, and this effort became ever more difficult as the experiments progressed and the back-up supply of engines was depleted faster than replacements could be obtained.

CHLOROCARBON AND SULFUR HEXAFLUORIDE ANALYSIS

All analyses were conducted via electron capture gas chromatography. Sulfur hexafluoride was measured using a Systems, Science and Software Model 215AUP SF₆ monitor^(a) with a 0.76 m by 0.64 cm OD copper column packed with alumina. Aliquots were withdrawn through the pinch clamp sealed Tygon[®] tube attached to the nipple of the polyethylene bags and transferred to the gas chromatograph with a 30 cc syringe. A gas sampling valve with a 2cc sample loop was used for injection into the ultrapure nitrogen carrier gas. Both the column and detector (tritiated titanium electron capture detector) were operated at ambient temperatures. Previous experience with this analyzer has demonstrated linear detector response to well beyond 1000 ppt. However, during the course of this work, samples showing concentrations greater than 1000 ppt were reanalyzed by diluting a measured aliquot of the sample with ultrapure nitrogen. Replicate analysis of these high concentration samples generally showed a precision of better than 5 %. A 310 ppt primary standard SF₆ in ultrapure air mixture was used to quantify detector response and verify stable performance throughout the analysis period. Sample chromatograms were recorded with a strip chart recorder and SF₆ peaks quantified from peak height.

Samples collected in 5-layer aluminized bags were analyzed for chlorocarbons by electron capture gas chromatography using a 1.22-m by 2-mm ID through the bag septum using an all-glass syringe for transfer to a gas sampling valve for injection. Use of an all-glass syringe has been demonstrated to provide transfer that is free of memory effects. Tests

(a) Systems, Science and Software, La Jolla, California.

® Trademark of Norton Company, Worcester, Massachusetts.

have also shown that sample integrity is preserved when the syringe is sealed by inserting the needle in a rubber septum and the sample stored for up to 20 min before injection. Selected samples showing the presence of the chlorocarbon test gas were subjected to replicate analysis and showed a precision of better than 15% at concentrations of 5 ppb and 17-38% at lower concentration levels. Qualitative identification of chromatograph peaks was based on retention time. Peak areas were measured with a Hewlett Packard Model 3380A^(a) integrating recorder and quantified by the use of an external standard perchlorethylene (CCl_2CCl_2) in air mixture and the measured relative response factors for the test gases carbon tetrachloride (CCl_4) and methyl chloroform (CH_3CCl_3). The perchloroethylene permeation tube was held at a constant temperature in an AID Model 309^(b) gas calibrator in which compressed air (breathing quality) served as the dilution gas.

QUALITY ASSURANCE PROBLEMS ASSOCIATED WITH CHLOROCARBON TRACERS

Although the pumps used to fill sample bags on sampling arcs during SF_6 and chlorocarbon releases had seen extensive field use, they had not been employed previously for the collection of gases other than SF_6 . A series of laboratory experiments were therefore conducted to evaluate the potential for analyte losses attributable to adsorption on pump or transfer line surfaces. Unanticipated problems encountered during these experiments resulted in a modification of the original experimental plan, and additional laboratory tests were required to assist in the interpretation of the results.

Initial laboratory experiments were conducted using an AID Model 309 calibrator with a permeation tube source. Gas samples from this device were sampled with the bag-filling pump and the exhaust stream analyzed to determine in-line losses. The sample was taken from the side arm of a

(a) Hewlett-Packard, Inc., Avondale, Pennsylvania.

(b) Analytical Instrument Development, Inc., Westchester, Pennsylvania.

Teflon^{®(a)} tee in the outlet flow from the gas calibrator and transported to the pump in 0.64 cm OD Teflon[®] tubing. The composition of the lengths of tubing attached to the exhaust port of the sampling pump was varied to assess their potential for adsorbing perchloroethylene, the chlorocarbon to be used during the first field tracer release. As a precaution against the accumulation of perchloroethylene in laboratory air, excess flow from the calibrator was passed through a charcoal trap before venting to a laboratory exhaust fan. The results of these tests generally indicated concentration changes of <12% in all cases, except where 135 ppb perchloroethylene was sampled and expelled through downstream tubing composed of Tygon[®]. In that case, a 41% change was found.

Additional tests with other pumps revealed that some were heavily contaminated with perchloroethylene; all had been contaminated to some degree. The contamination appears to have come from a commercial product used to clean electronic contacts. This contamination had not been immediately apparent in the initial test results, since the exhaust concentration was never found to be greater than the source concentration. When this contamination was discovered, carbon tetrachloride and methyl chloroform were substituted as tracer gases. No changes were made in the sampling equipment since Tygon[®] tubing was not used at sampling sites designated for the collection of samples to be analyzed for chlorocarbons.

During the analysis of the chlorocarbon tracer results, it became apparent that the concentrations of such tracers, normalized by the amount of tracer released, was consistently lower than that for SF₆ at the same location. As a result, the operation of the pumps was reexamined. A series of experiments was conducted to evaluate the efficiency of transfer of the chlorocarbon tracers to an empty 5-layer bag via the pulse pumps used in the field tests. Two principal results were found. The first was that sample concentrations were generally affected by leakage of ambient air into the pumps. The second was that passage through the pumps themselves resulted in losses of apparent chlorocarbon concentration on the

(a) [®] Trademark of E.I. duPont de Nemours and Co., Inc., Wilmington, Delaware.

order of 40% or more, while the SF₆ concentration was essentially unaltered. Deposition losses for the chlorocarbons were expected to be considerably less than 40%. Examination of the field data revealed no systematic depletion of chlorocarbon concentration with distance, which is consistent with small deposition losses.

The first result was actually not a problem, since the ambient air during the sampling process had the same concentration of tracer as the air being drawn through the pump. The loss in the pumps of the chlorocarbons was more serious, since the amount appeared variable and difficult to quantify. The perchloroethylene contamination in the pumps was apparently enough to offset losses that would have been observed in the passage through the pumps during the original tests. Hence, while the SF₆ results should be valid, the attempts to measure chlorocarbon tracer concentrations in the field must be regarded as unsuccessful.

In view of the sampling difficulties encountered with the chlorocarbon tracers, it is appropriate to consider alternative approaches for their measurement in future work. The use of pumps to fill sampling bags seems to have only limited application. A cost-effective and technically acceptable alternative appears to be the use of adsorption tubes, such as those employed to define work place exposure to industrial chemicals, to concentrate the analyte upstream of the pump. Adsorption and possible contaminant desorption problems would be eliminated by avoiding sample contact with the pump and associated transport lines. The existing set of pumps could still be used to pull air through the adsorption tubes. While the tubes are not reuseable, they are significantly cheaper than the multilayer sampling bags. In cases where SF₆ was also to be measured, however, the use of bags or syringes is still warranted.

APPENDIX B

METEOROLOGICAL DATA

This appendix contains summaries of the meteorological conditions during tracer releases carried out in May and June of 1983. The data are of several kinds. Tables B-1 through B-6 provide tabulated values of the three components of the wind, the horizontal wind speed, the temperature, the wind direction (DIR) and standard deviations of the wind direction fluctuations in the horizontal (SIG TH) and the vertical (SIG PHI) directions. These data are provided at seven levels for the tracer release period and for an equal time period following the release. For reference, it is useful to know that a wind from an azimuth of 295 degrees blew approximately down the centers of the sampling arcs. Values of 999 in these tables indicate missing or bad data.

Table B-7 gives a listing of the friction velocity u_* and the Monin-Obukhov length L determined during each tracer release, and their method of determination, i.e., from the sonic anemometer and fast temperature system or from profiles of mean wind and temperature values. Sonic values, when available, were used in our analyses.

These tables are followed by a series of figures that show the wind and temperature profiles, time histories of the wind speed and direction at 2 m (beginning with the initiation of the release of the tracers), and a histogram of wind direction at 2 m.

TABLE B-1. METEOROLOGICAL DATA FOR RELEASE OF MAY 18, 1983

JULIAN DAY = 138; 30 MIN AVERAGE ENDING AT 23:18:0.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	1.64	2.25	3.40	4.00	4.51	5.55	6.34
V (m/s)	2.09	2.85	4.27	5.09	6.22	7.35	9.02
W (m/s)	999.	0.02	0.03	0.61	0.33	0.43	999.
T (°C)	14.6	14.7	999.	14.9	14.9	14.9	14.9
SPEED (m/s)	2.65	3.63	5.46	6.47	7.68	9.21	11.02
DIR (deg)	308.	308.	309.	308.	306.	307.	305.
SIG TH (deg)	16.3	13.0	9.8	8.0	6.9	5.5	4.2
SIG PHI (deg)	999.	4.1	6.1	5.4	5.7	4.6	3.3

JULIAN DAY = 138; 30 MIN AVERAGE ENDING AT 23:48:1.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	1.43	1.94	2.94	3.53	4.03	5.00	5.96
V (m/s)	2.04	2.87	4.27	5.20	6.37	7.39	9.33
W (m/s)	999.	-0.01	0.06	0.55	0.33	0.50	999.
T (°C)	14.3	14.4	999.	14.6	14.7	14.6	14.7
SPEED (m/s)	2.49	3.47	5.19	6.29	7.54	8.92	11.07
DIR (deg)	305.	304.	305.	304.	302.	304.	303.
SIG TH (deg)	16.2	12.9	9.6	7.8	6.7	5.4	3.8
SIG PHI (deg)	999.	4.5	6.7	5.7	5.9	4.7	3.3

TABLE B-2. METEOROLOGICAL DATA FOR RELEASE OF MAY 26, 1983

JULIAN DAY = 146; 30 MIN AVERAGE ENDING AT 23:54:1.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	0.37	0.55	1.01	1.38	1.84	3.06	4.91
V (m/s)	0.86	1.31	2.07	2.66	3.51	4.74	6.73
W (m/s)	999.	-0.01	0.02	0.25	0.14	0.25	999.
T (°C)	19.2	19.5	999.	20.5	20.7	21.0	22.2
SPEED (m/s)	0.94	1.42	2.30	2.99	3.96	5.64	8.33
DIR (deg)	293.	293.	296.	297.	298.	303.	306.
SIG TH (deg)	16.6	12.8	9.8	7.7	6.7	4.3	1.8
SIG PHI (deg)	999.	3.5	5.4	5.0	4.9	3.6	1.5

JULIAN DAY = 147; 30 MIN AVERAGE ENDING AT 0:24:0.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	0.20	0.32	0.70	1.07	1.59	2.89	4.67
V (m/s)	0.75	1.21	2.08	2.74	3.80	4.90	6.60
W (m/s)	999.	-0.03	0.00	0.23	0.12	0.27	999.
T (°C)	18.1	18.4	999.	19.6	20.1	20.6	21.8
SPEED (m/s)	0.78	1.25	2.19	2.94	4.12	5.70	8.09
DIR (deg)	285.	285.	288.	291.	293.	301.	305.
SIG TH (deg)	14.1	10.6	7.4	5.9	4.7	3.4	2.2
SIG PHI (deg)	999.	3.5	3.9	3.6	3.3	2.8	1.4

TABLE B-3. METEOROLOGICAL DATA FOR RELEASE OF JUNE 5, 1983

JULIAN DAY = 156; 30 MIN AVERAGE ENDING AT 22:40:0.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	0.47	0.62	1.11	1.40	1.64	2.53	3.51
V (m/s)	1.27	1.93	3.00	3.68	4.59	5.52	6.93
W (m/s)	999.	-0.02	0.13	0.15	0.20	0.33	999.
T (°C)	17.3	17.5	17.7	18.0	18.0	18.0	18.2
SPEED (m/s)	1.35	2.02	3.20	3.94	4.88	6.07	7.77
DIR (deg)	290.	288.	290.	291.	290.	295.	297.
SIG TH (deg)	16.1	13.1	10.3	8.1	7.2	5.7	4.7
SIG PHI (deg)	999.	3.7	6.0	5.6	5.0	4.4	3.5

JULIAN DAY = 156; 30 MIN AVERAGE ENDING AT 23:10:1.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	0.28	0.39	0.71	0.90	1.12	1.95	2.86
V (m/s)	1.21	1.88	2.95	3.58	4.64	5.51	6.53
W (m/s)	999.	-0.02	0.10	0.11	0.12	0.27	999.
T (°C)	16.8	17.0	17.2	17.5	17.7	17.8	18.0
SPEED (m/s)	1.24	1.92	3.03	3.70	4.77	5.84	7.13
DIR (deg)	283.	282.	283.	284.	284.	290.	294.
SIG TH (deg)	15.1	12.4	9.3	7.9	6.3	5.6	5.2
SIG PHI (deg)	999.	4.2	5.6	5.2	4.3	3.7	3.2

TABLE B-4. METEOROLOGICAL DATA FOR RELEASE OF JUNE 12, 1983

JULIAN DAY = 163; 30 MIN AVERAGE ENDING AT 23:13:2.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	0.37	0.56	0.98	1.29	1.66	2.47	3.16
V (m/s)	0.91	1.40	2.22	2.90	3.99	5.15	6.31
W (m/s)	999.	-0.01	999.	0.04	0.05	0.19	999.
T (°C)	14.7	14.9	15.2	15.6	16.0	16.3	16.6
SPEED (m/s)	0.98	1.50	2.43	3.17	4.32	5.71	7.05
DIR (deg)	292.	292.	294.	294.	293.	296.	297.
SIG TH (deg)	16.0	13.7	9.8	8.1	6.1	3.9	2.8
SIG PHI (deg)	999.	3.8	999.	4.3	3.3	2.6	1.7

JULIAN DAY = 163; 30 MIN AVERAGE ENDING AT 23:43:2.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	0.24	0.37	0.74	1.08	1.49	2.36	2.97
V (m/s)	0.76	1.29	2.05	2.73	3.93	5.03	6.13
W (m/s)	999.	-0.03	999.	0.02	0.04	0.15	999.
T (°C)	13.9	14.2	14.6	15.0	15.8	16.2	16.4
SPEED (m/s)	0.80	1.34	2.19	2.94	4.20	5.56	6.81
DIR (deg)	288.	286.	290.	292.	291.	295.	296.
SIG TH (deg)	14.6	11.8	8.5	6.4	4.6	3.3	2.8
SIG PHI (deg)	999.	4.2	999.	3.8	2.7	2.3	1.6

TABLE B-5. METEOROLOGICAL DATA FOR RELEASE OF JUNE 24, 1983

JULIAN DAY = 175; 22 MIN AVERAGE ENDING AT 23:28:0.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	-0.03	-0.03	0.05	0.12	0.19	0.81	1.44
V (m/s)	0.70	1.41	1.95	2.55	3.55	4.33	5.34
W (m/s)	999.	-0.04	999.	-0.04	0.07	0.18	999.
T (°C)	13.8	14.1	14.4	14.8	15.4	15.6	15.8
SPEED (m/s)	0.70	1.41	1.95	2.55	3.55	4.40	5.53
DIR (deg)	268.	269.	271.	273.	273.	281.	285.
SIG TH (deg)	23.2	15.8	16.0	14.8	10.9	8.1	6.6
SIG PHI (deg)	999.	4.6	999.	3.8	3.9	4.4	4.2

JULIAN DAY = 175; 30 MIN AVERAGE ENDING AT 23:58:1.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	-0.34	-0.50	-0.73	-0.88	-0.86	-0.09	0.92
V (m/s)	0.30	0.78	1.23	1.85	2.86	3.45	4.20
W (m/s)	999.	-0.02	999.	-0.05	0.01	0.12	999.
T (°C)	12.1	12.4	12.8	13.5	14.8	15.2	15.6
SPEED (m/s)	0.45	0.92	1.43	2.05	2.98	3.45	4.31
DIR (deg)	221.	237.	239.	244.	253.	269.	282.
SIG TH (deg)	31.8	27.9	17.6	13.0	9.9	7.9	7.0
SIG PHI (deg)	999.	3.6	999.	3.0	3.2	4.7	4.8

TABLE B-6. METEOROLOGICAL DATA FOR RELEASE OF JUNE 27, 1983

JULIAN DAY = 178; 30 MIN AVERAGE ENDING AT 22:1:0

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	0.68	0.99	1.52	1.84	2.06	2.45	2.62
V (m/s)	0.80	1.19	1.88	2.40	3.14	3.64	4.55
W (m/s)	999.	-0.03	999.	-0.01	0.10	0.16	999.
T (°C)	20.2	20.5	20.8	21.5	21.6	21.6	21.7
SPEED (m/s)	1.05	1.54	2.42	3.02	3.76	4.39	5.25
DIR (deg)	310.	310.	309.	307.	303.	304.	300.
SIG TH (deg)	18.9	14.9	12.3	11.0	9.0	8.0	7.3
SIG PHI (deg)	999.	4.7	999.	4.2	4.6	4.9	5.2

JULIAN DAY = 178; 30 MIN AVERAGE ENDING AT 22:31:0.

	1M	2M	4M	8M	16M	32M	61M
U (m/s)	0.44	0.62	1.05	1.25	1.47	2.20	3.02
V (m/s)	1.14	2.01	2.66	3.31	4.26	4.99	6.02
W (m/s)	999.	-0.03	999.	-0.05	0.13	0.18	999.
T (°C)	20.1	20.3	20.5	20.9	21.0	21.1	21.2
SPEED (m/s)	1.22	2.10	2.86	3.54	4.51	5.46	6.74
DIR (deg)	291.	287.	292.	291.	289.	294.	297.
SIG TH (deg)	16.2	11.4	9.8	8.1	7.3	6.1	5.2
SIG PHI (deg)	999.	5.0	999.	4.8	4.9	4.3	3.8

TABLE B-7. TURBULENCE DATA FOR TRACER RELEASE PERIODS

<u>Release date</u>	<u>U_* (sonic*) (cm/s)</u>	<u>U_* (profile) (cm/s)</u>	<u>L (sonic*) (m)</u>	<u>L (profile) (m)</u>
May 18, 1983	40	47	166	182
May 26, 1983	26	18	44	29
June 5, 1983	--	27	--	77
June 12, 1983	--	20	--	34
June 24, 1983	26	17	59	45
June 27, 1983	30	21	71	109

* During the first two tracer release, sonic data were available for only 26 and 20 minutes, respectively. However, conditions were judged sufficiently stationary so that turbulence values derived during these periods are applicable for the full 30 minute release time.

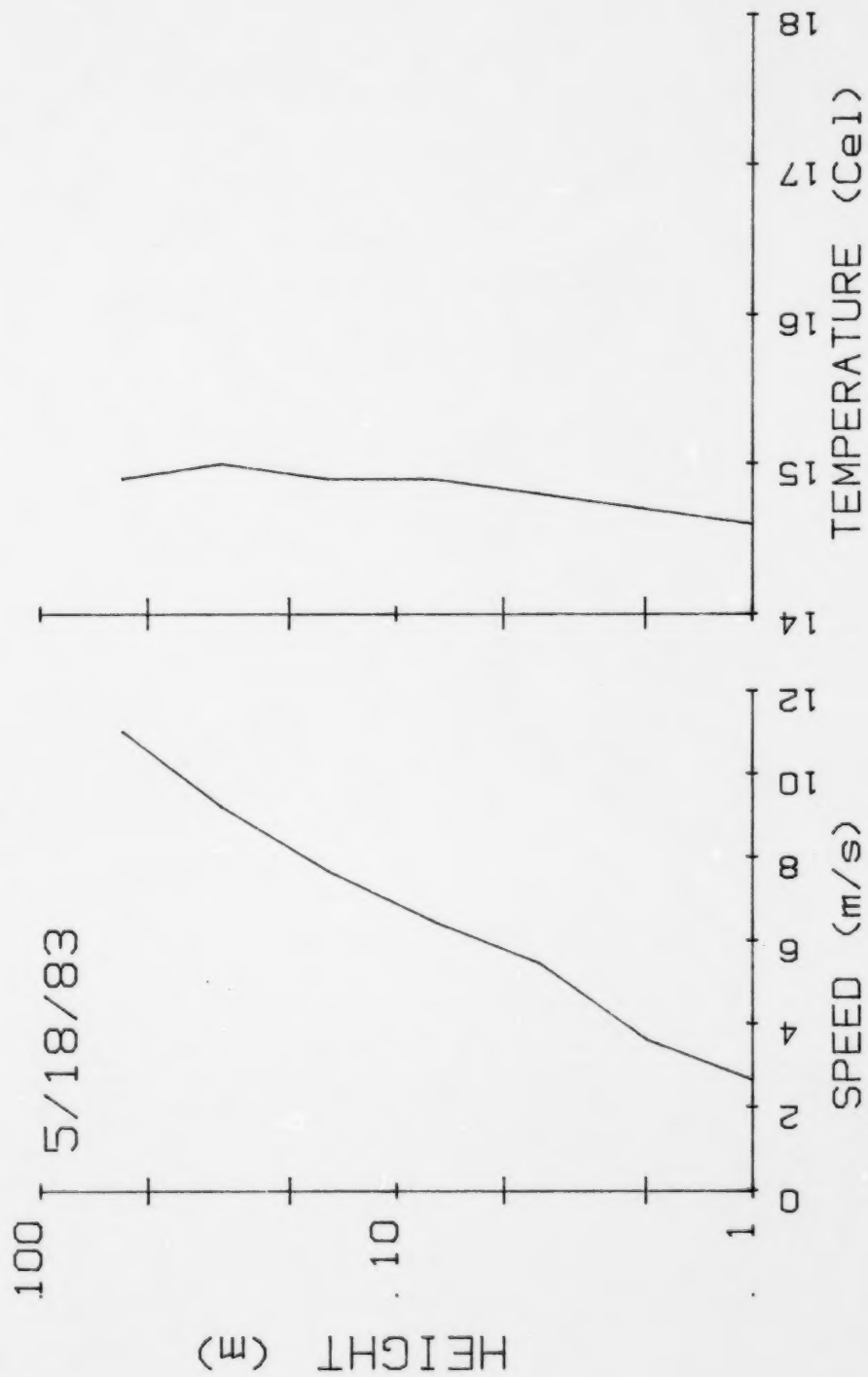


Figure B-1. Speed and temperature profiles for release of May 18, 1983.

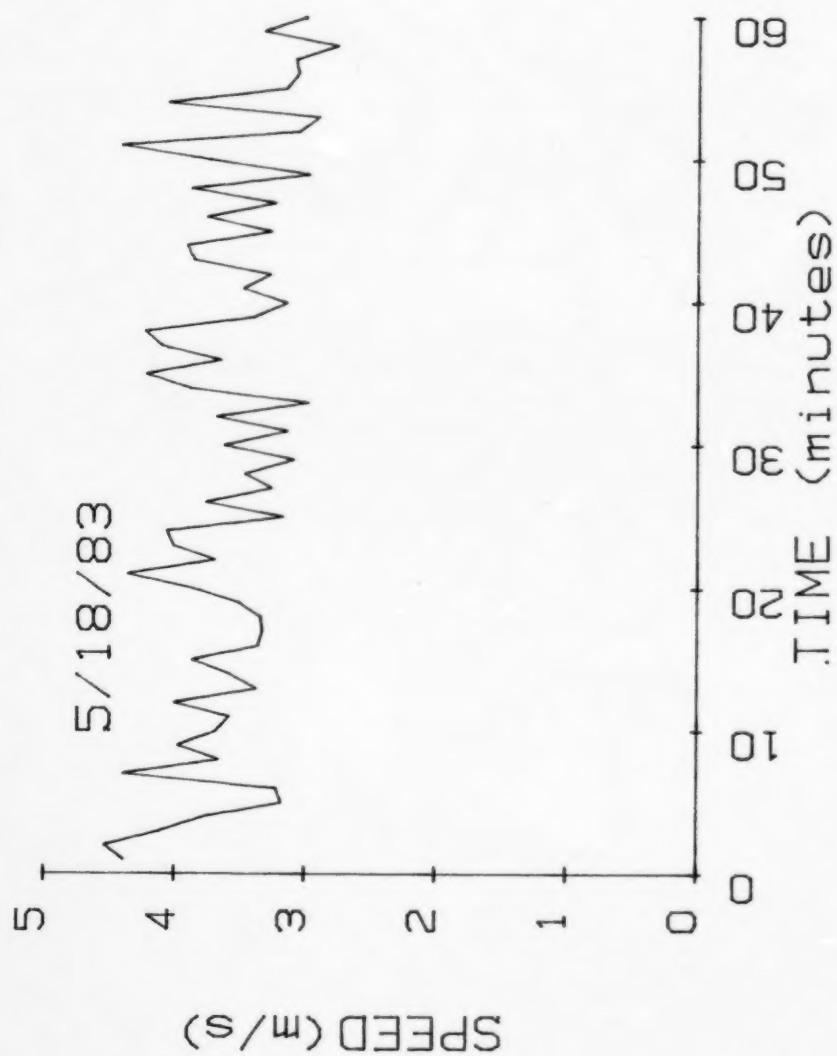


Figure B-2. Wind speed at 2 m on May 18, 1983.

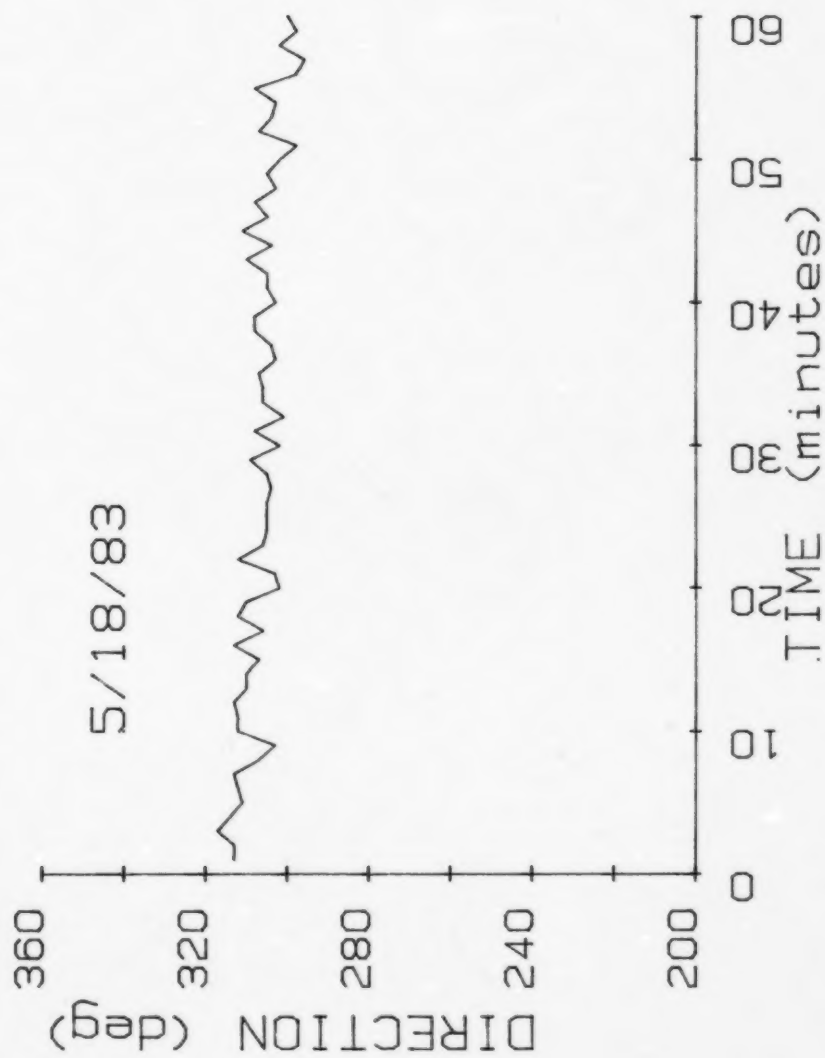


Figure B-3. Wind direction at 2 m on May 18, 1983.

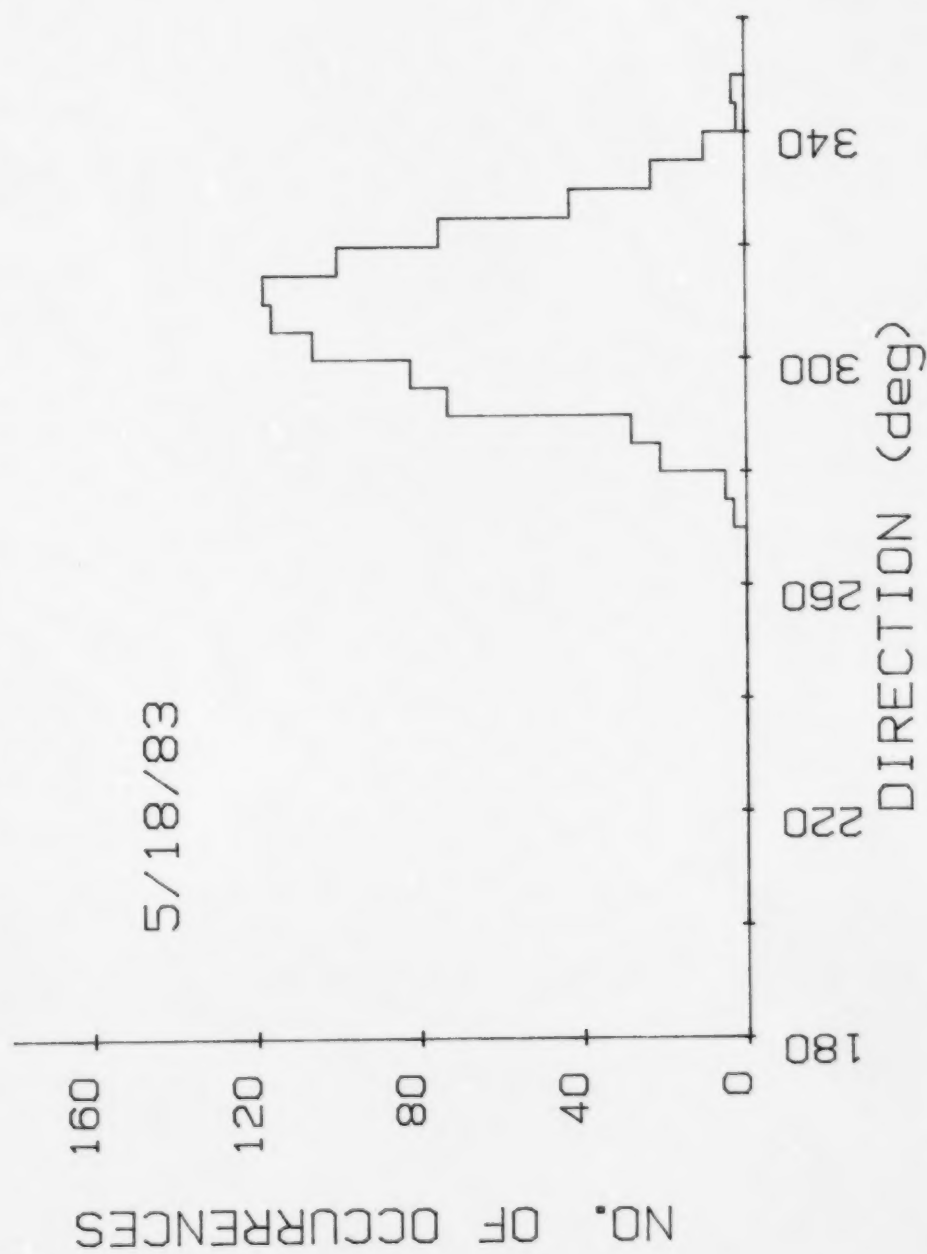


Figure B-4. Wind direction histogram for May 18, 1983.

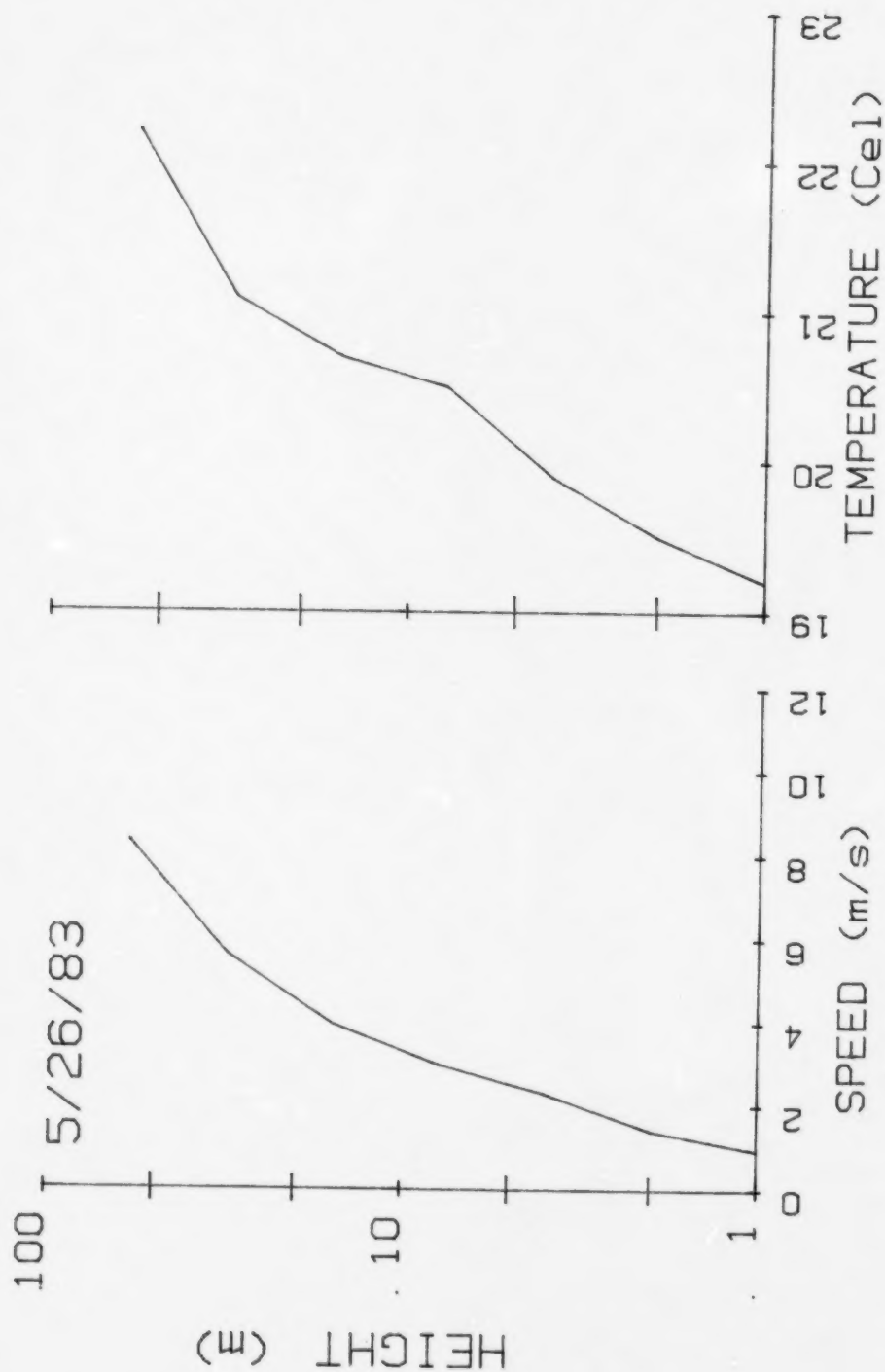


Figure B-5. Speed and temperature profiles for release of May 26, 1983.

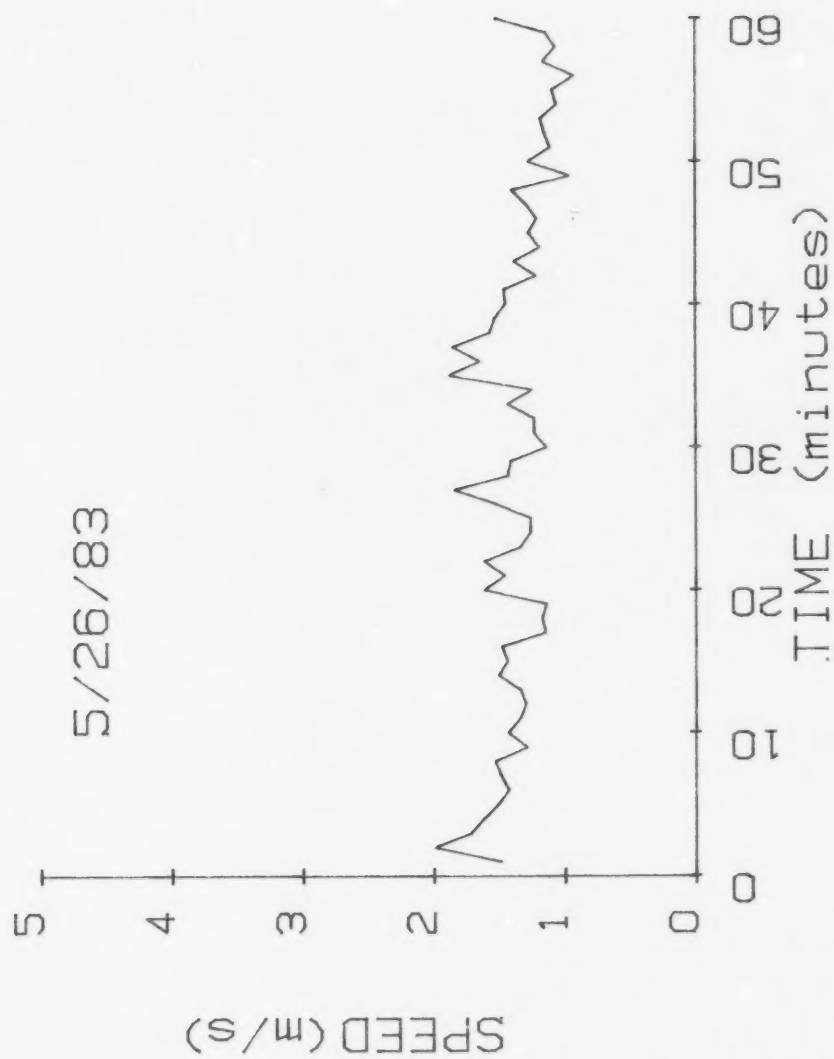


Figure B-6. Wind speed at 2 m on May 26, 1983.

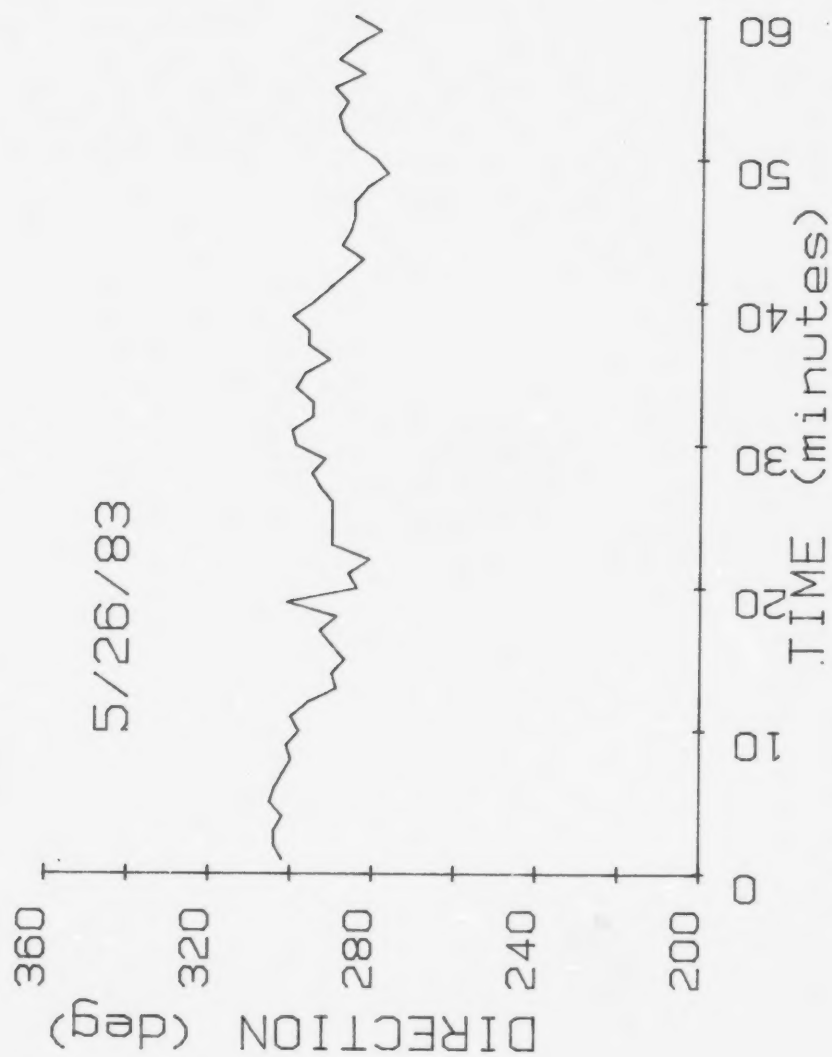


Figure B-7. Wind direction at 2 m on May 26, 1983.

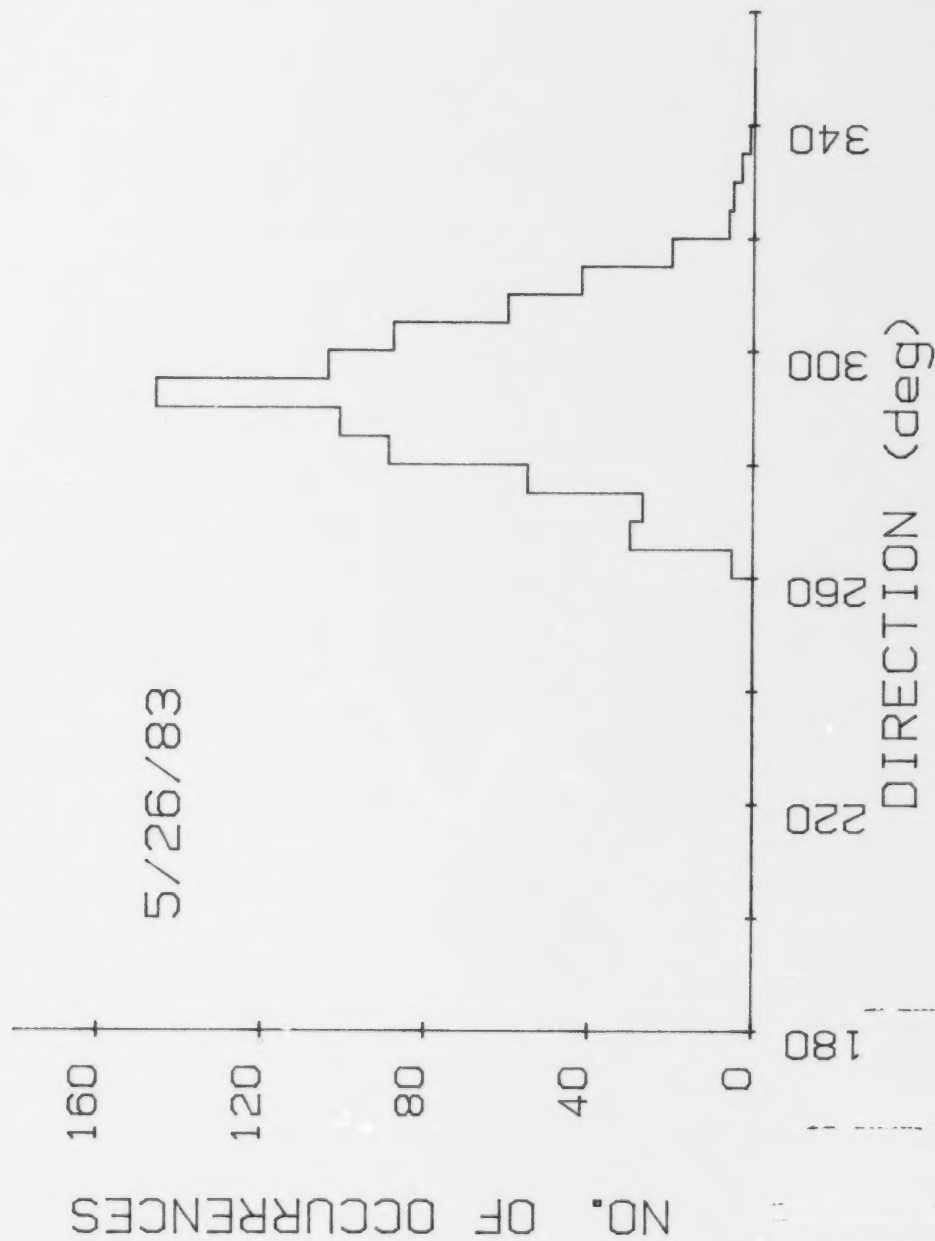


Figure B-8. Wind direction histogram for May 26, 1983.

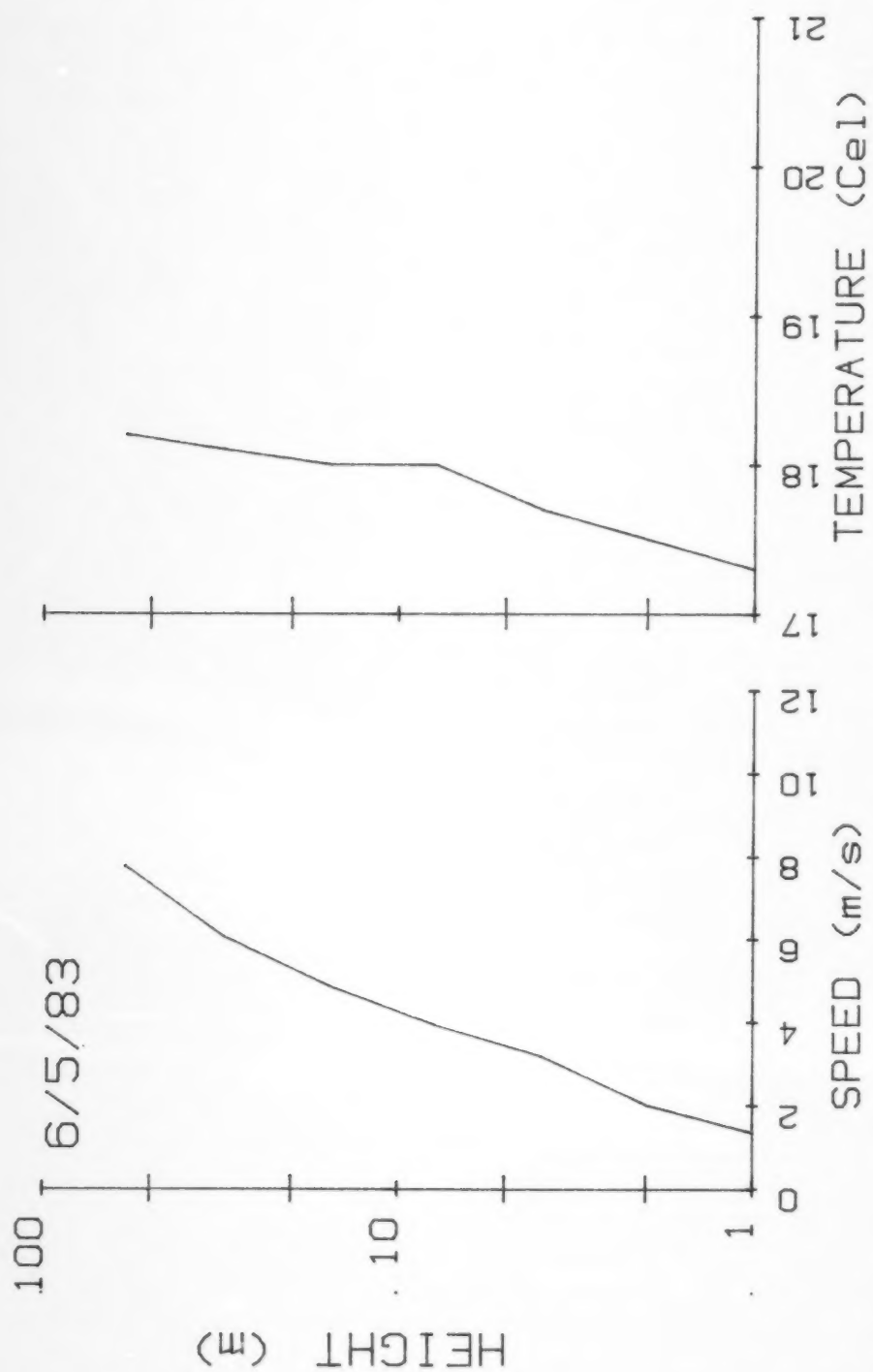


Figure B-9. Speed and temperature profiles for release of June 5, 1983.

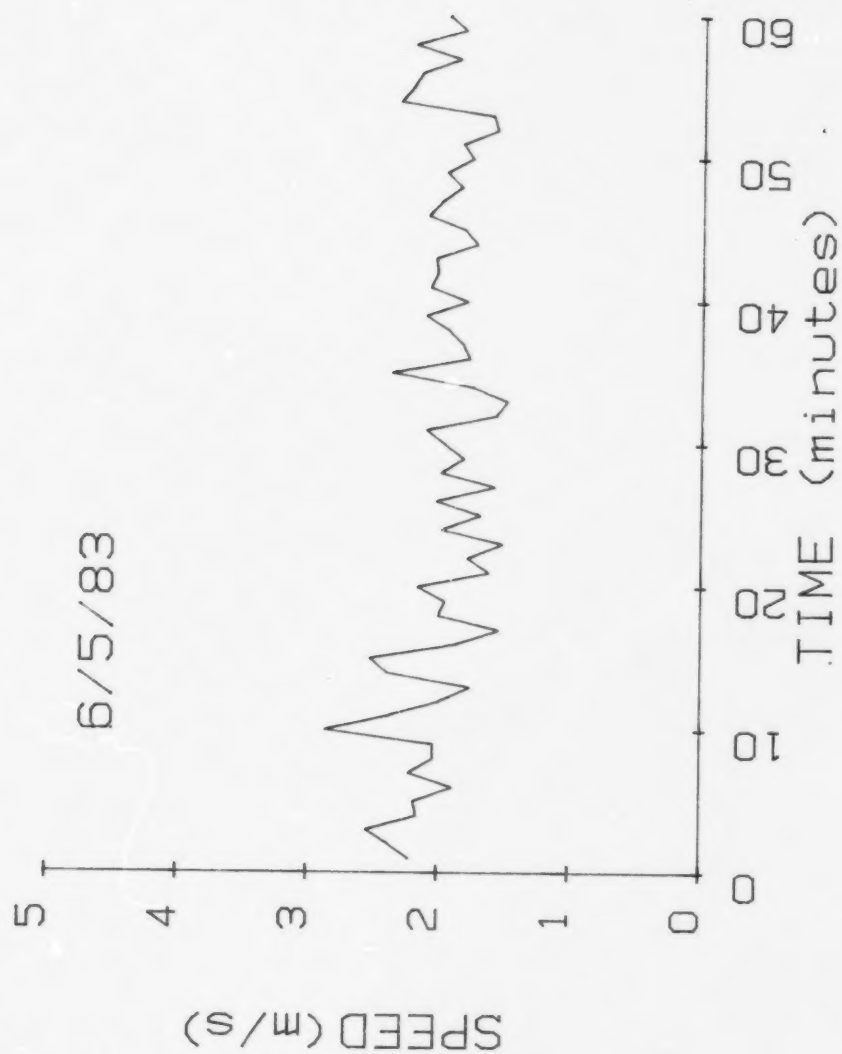


Figure B-10. Wind speed at 2 m on June 5, 1983.

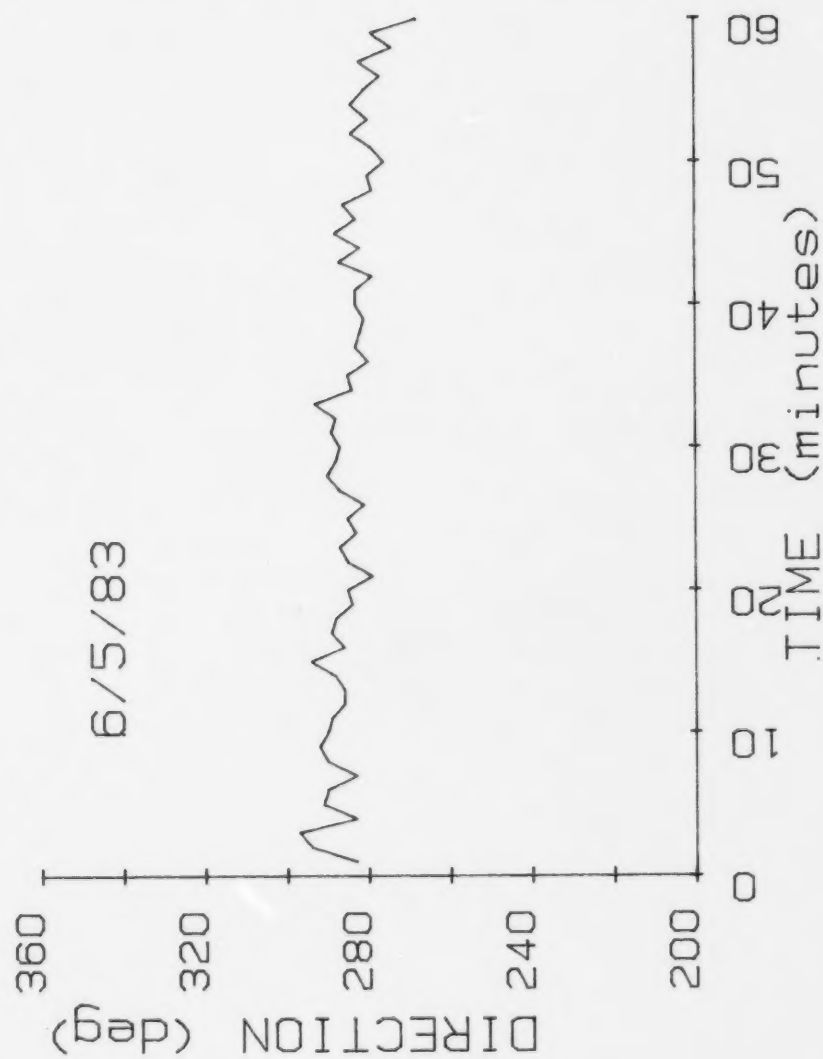


Figure B-11. Wind direction at 2 m on June 5, 1983.

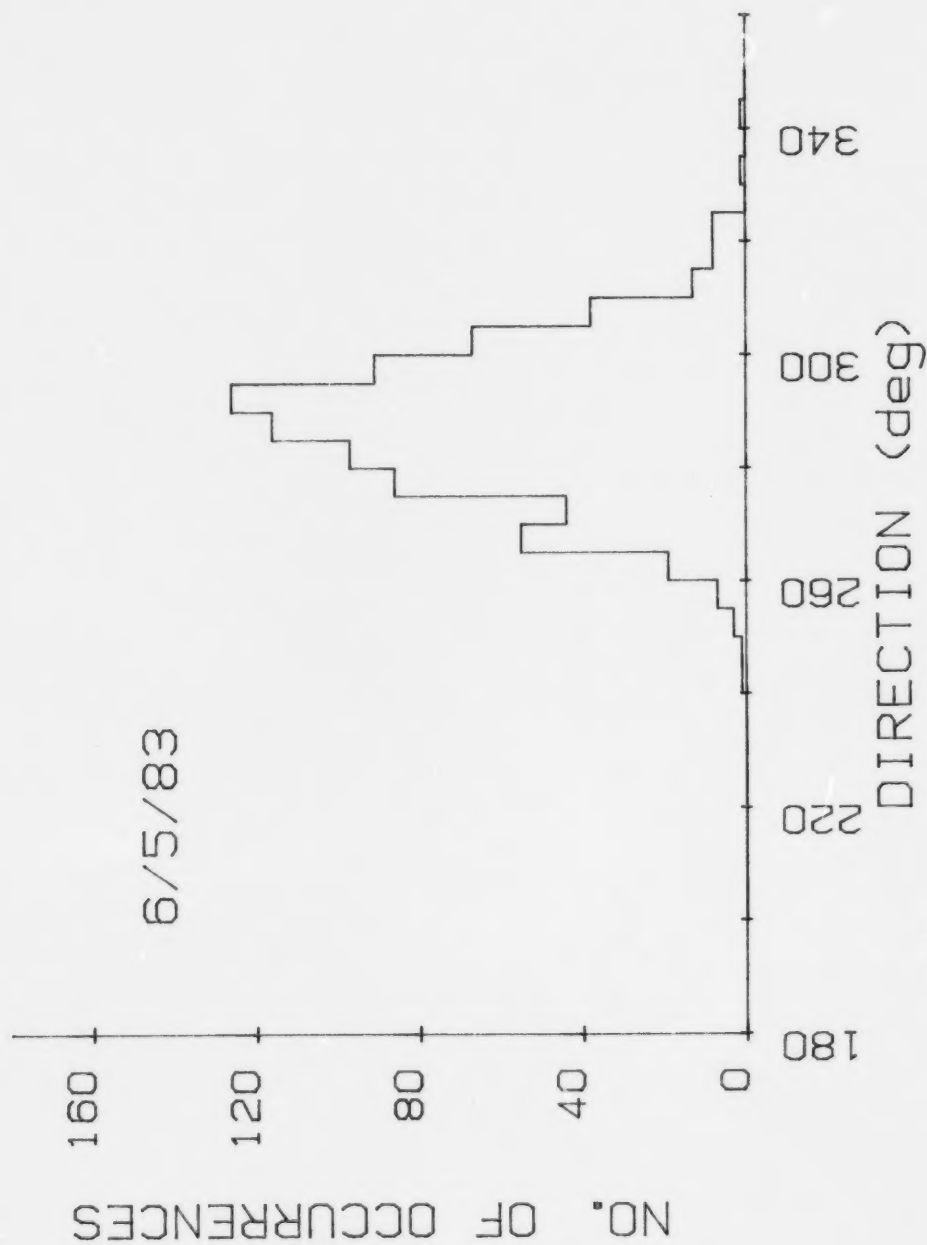


Figure B-12. Wind direction histogram for June 5, 1983.

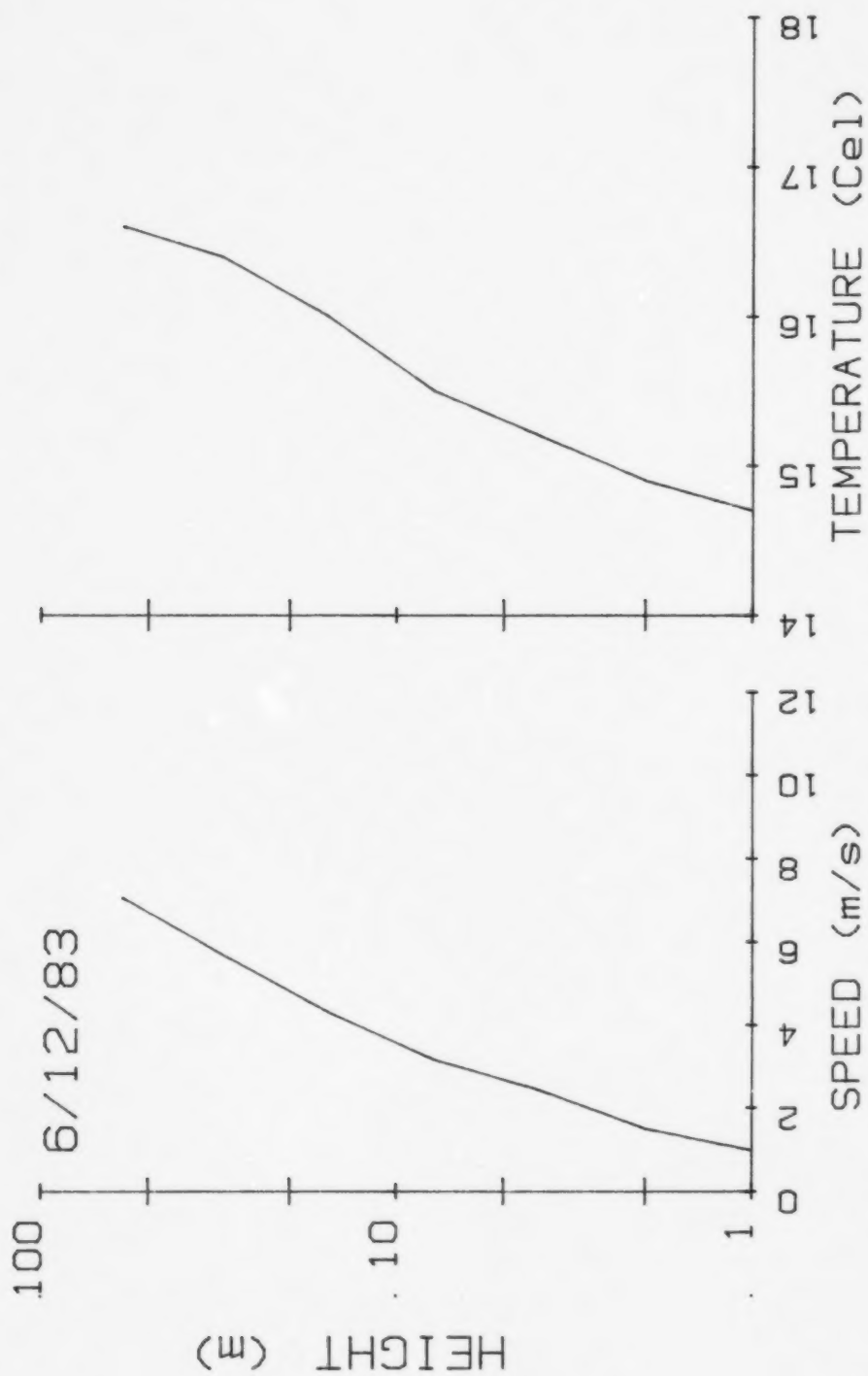


Figure B-13. Speed and temperature profiles for release of June 12, 1983.

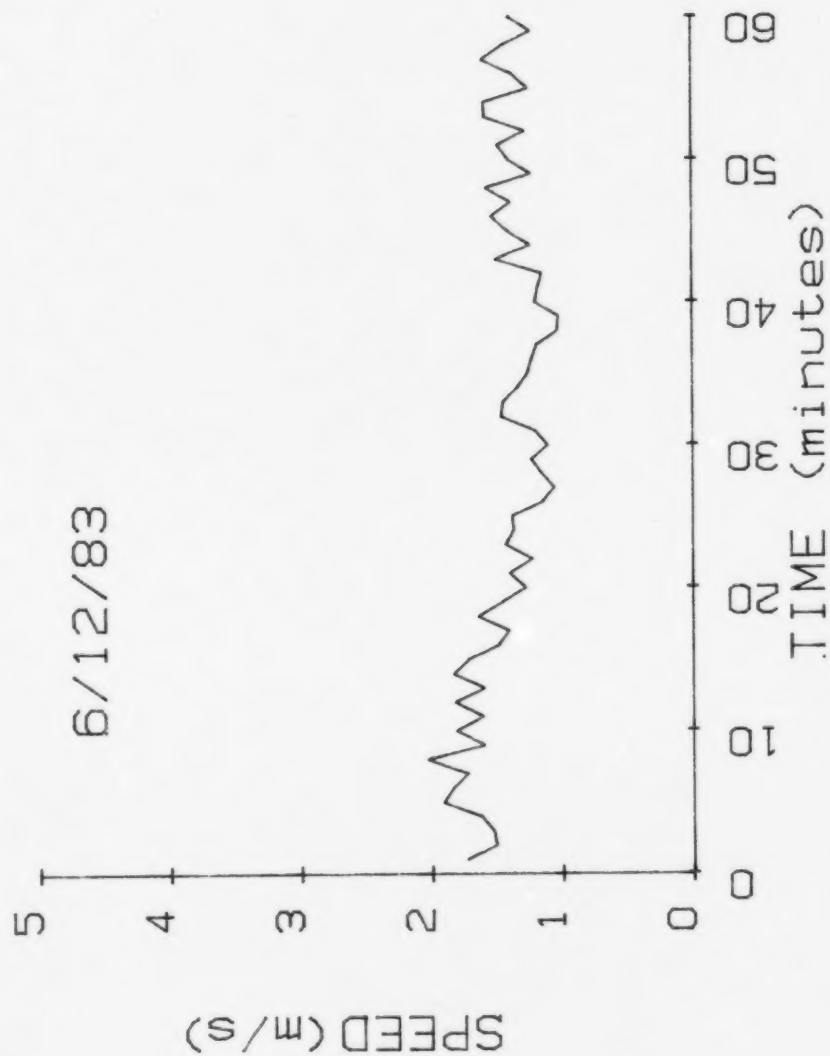


Figure B-14. Wind speed at 2 m on June 12, 1983.

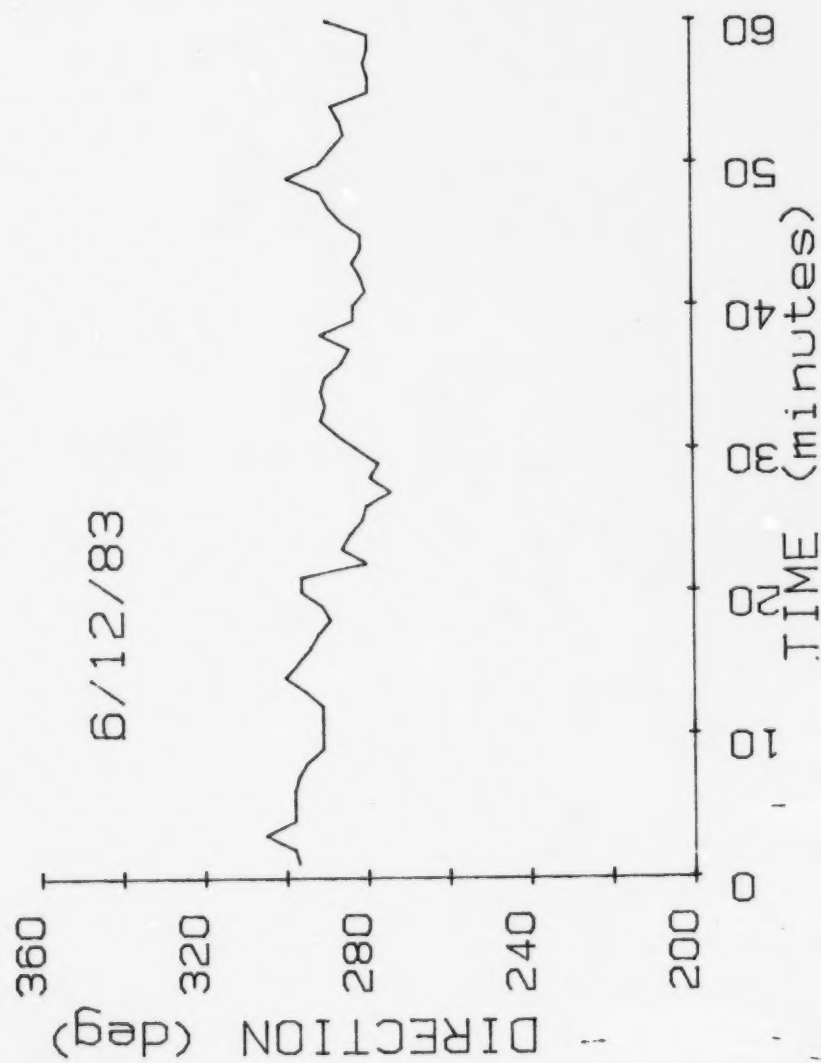


Figure B-15. Wind direction at 2 m on June 12, 1983.

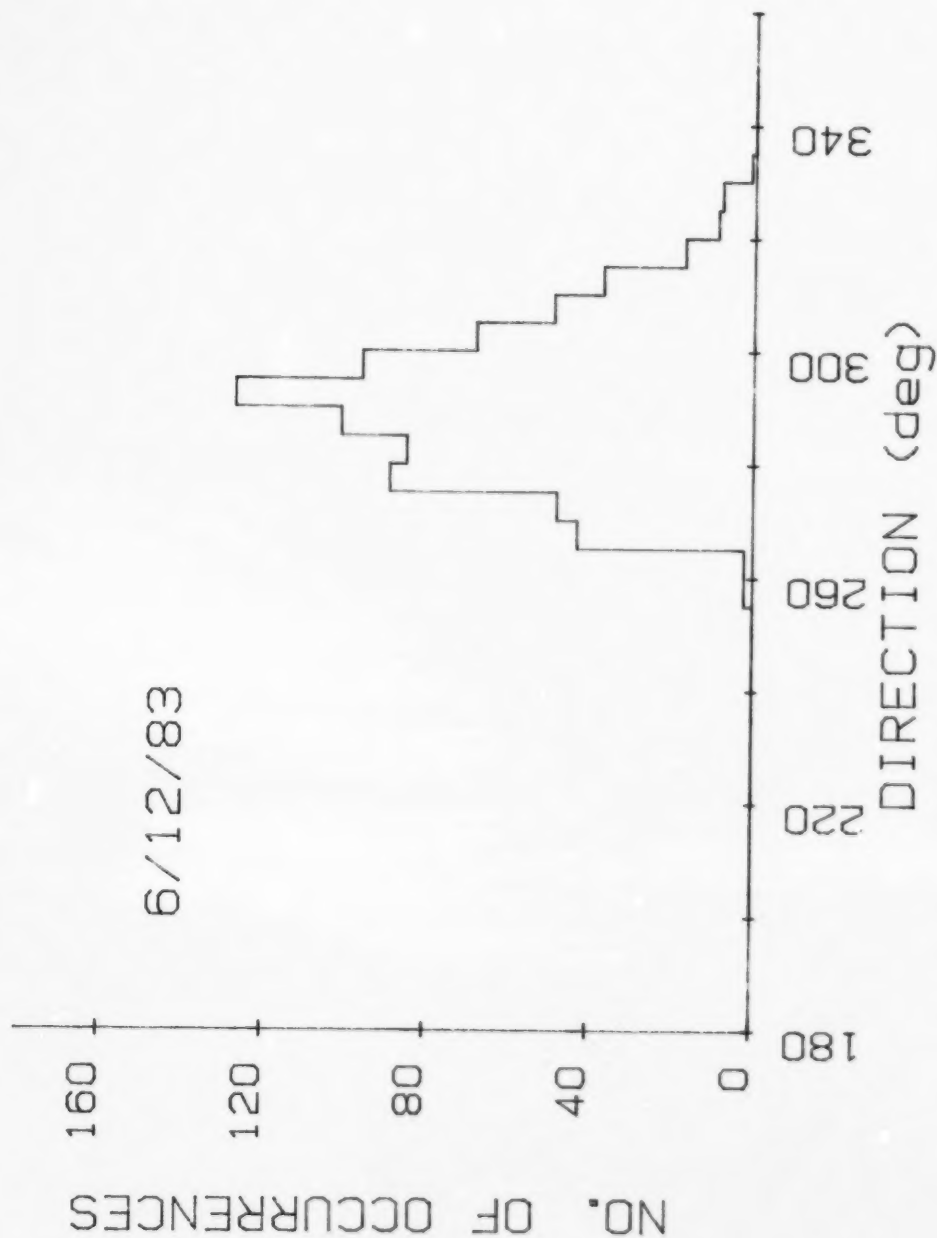


Figure B-16. Wind direction histogram for June 12, 1983.

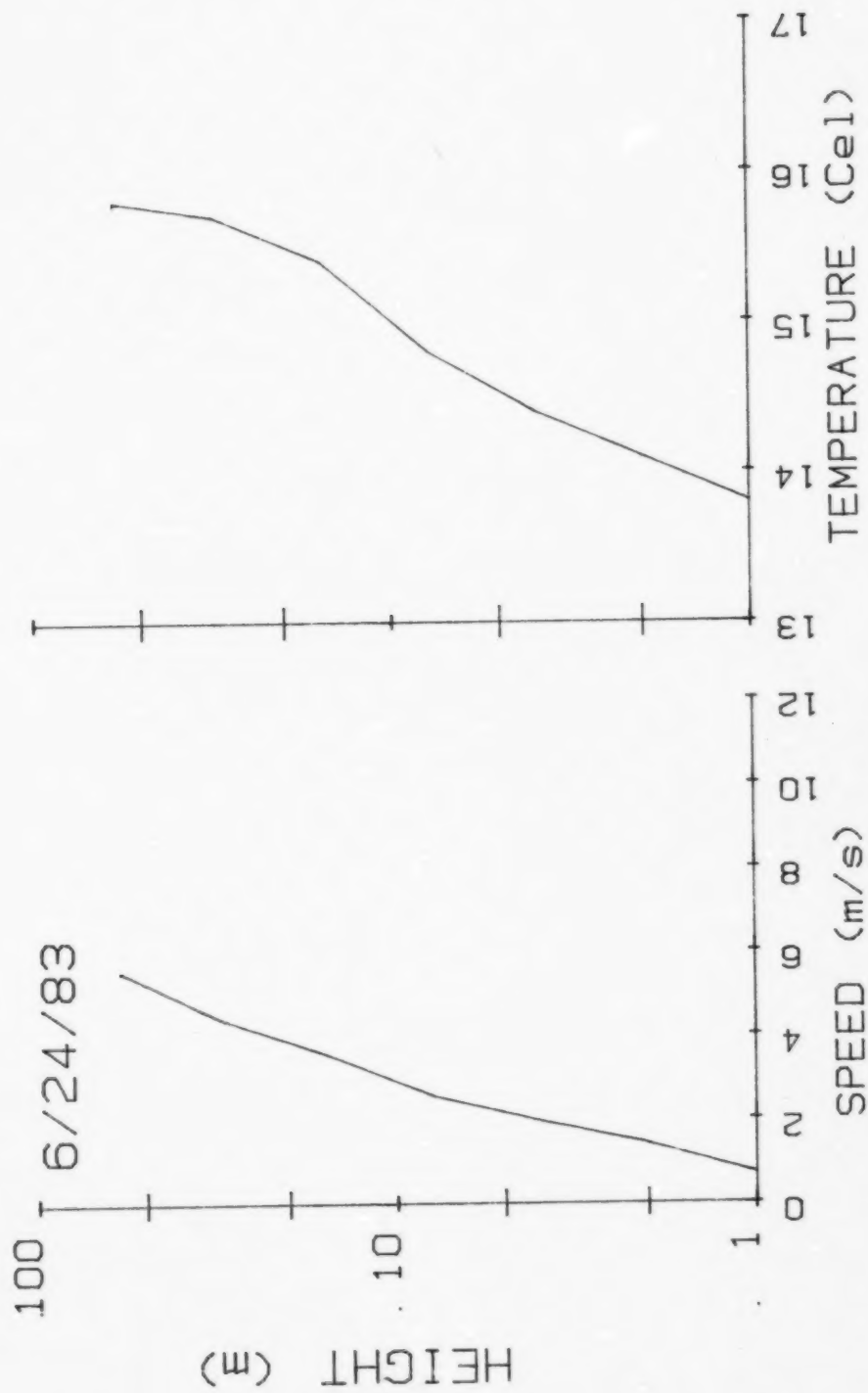


Figure B-17. Speed and temperature profiles for release of June 24, 1983.

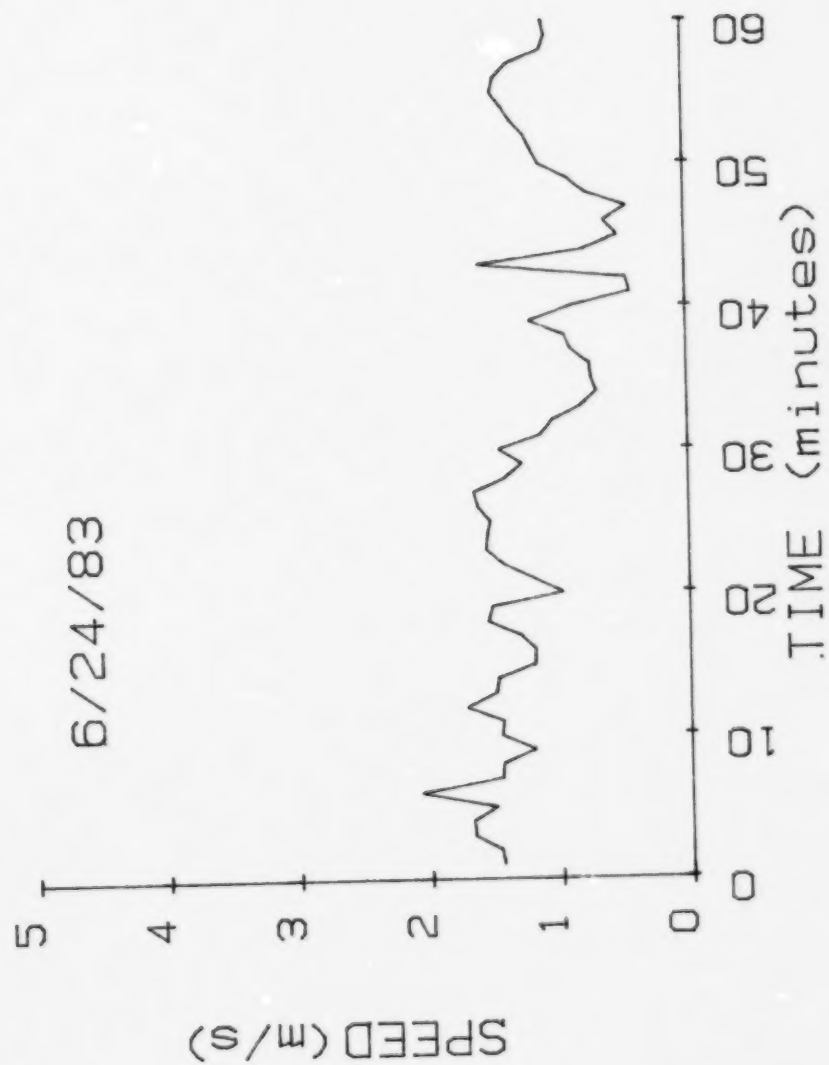


Figure B-18. Wind speed at 2 m on June 24, 1983.

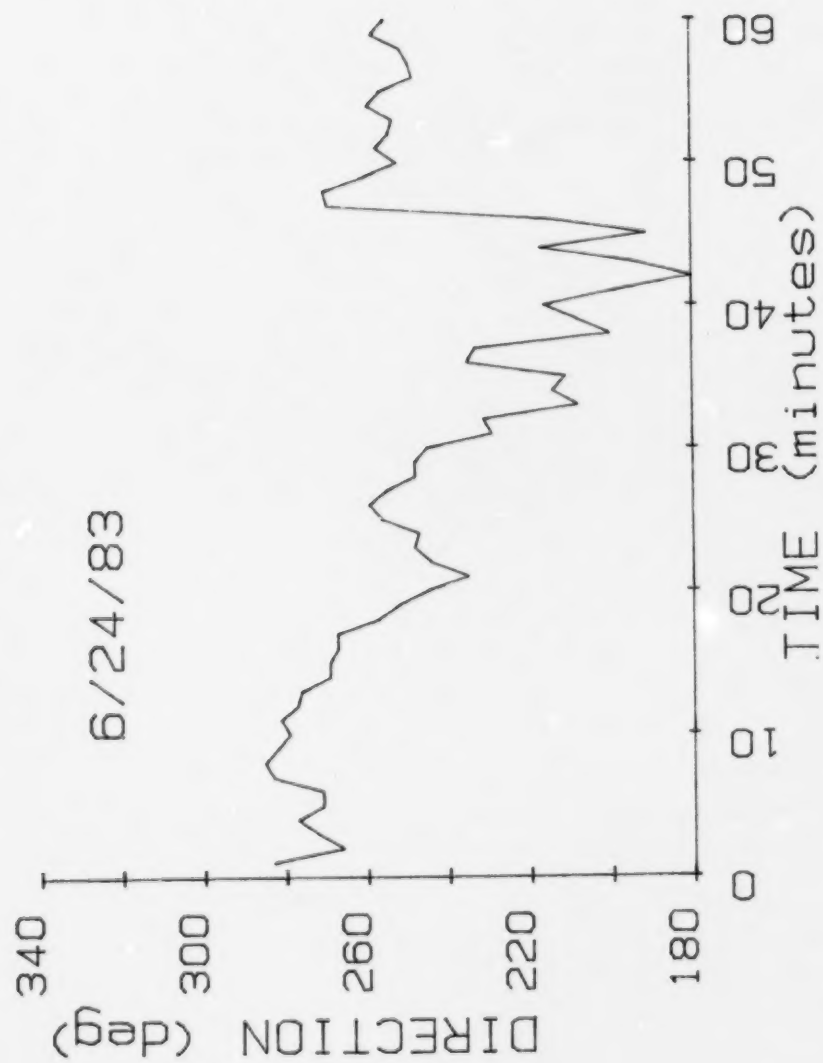


Figure B-19. Wind direction at 2 m on June 24, 1983.

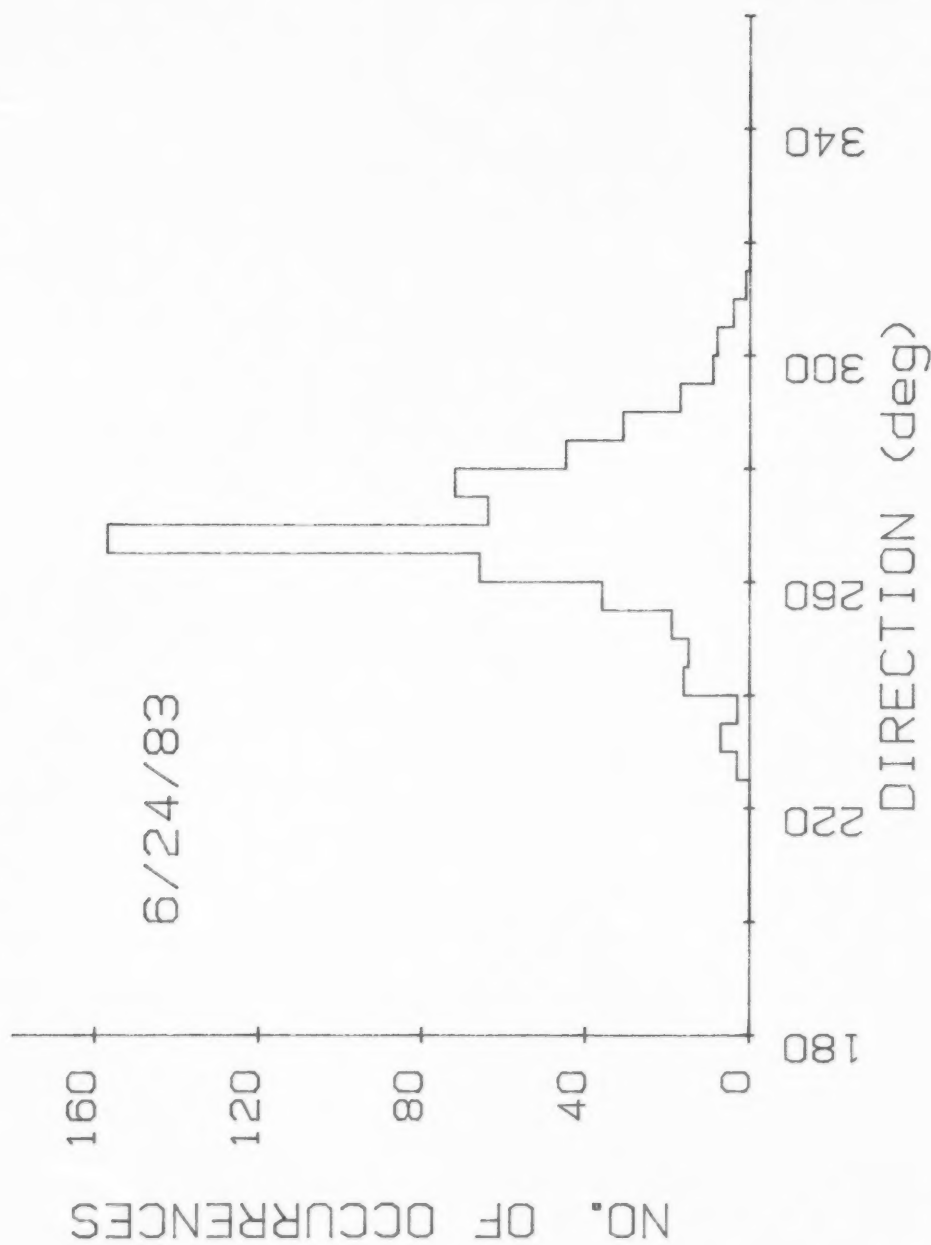


Figure B-20. Wind direction histogram for June 24, 1983.

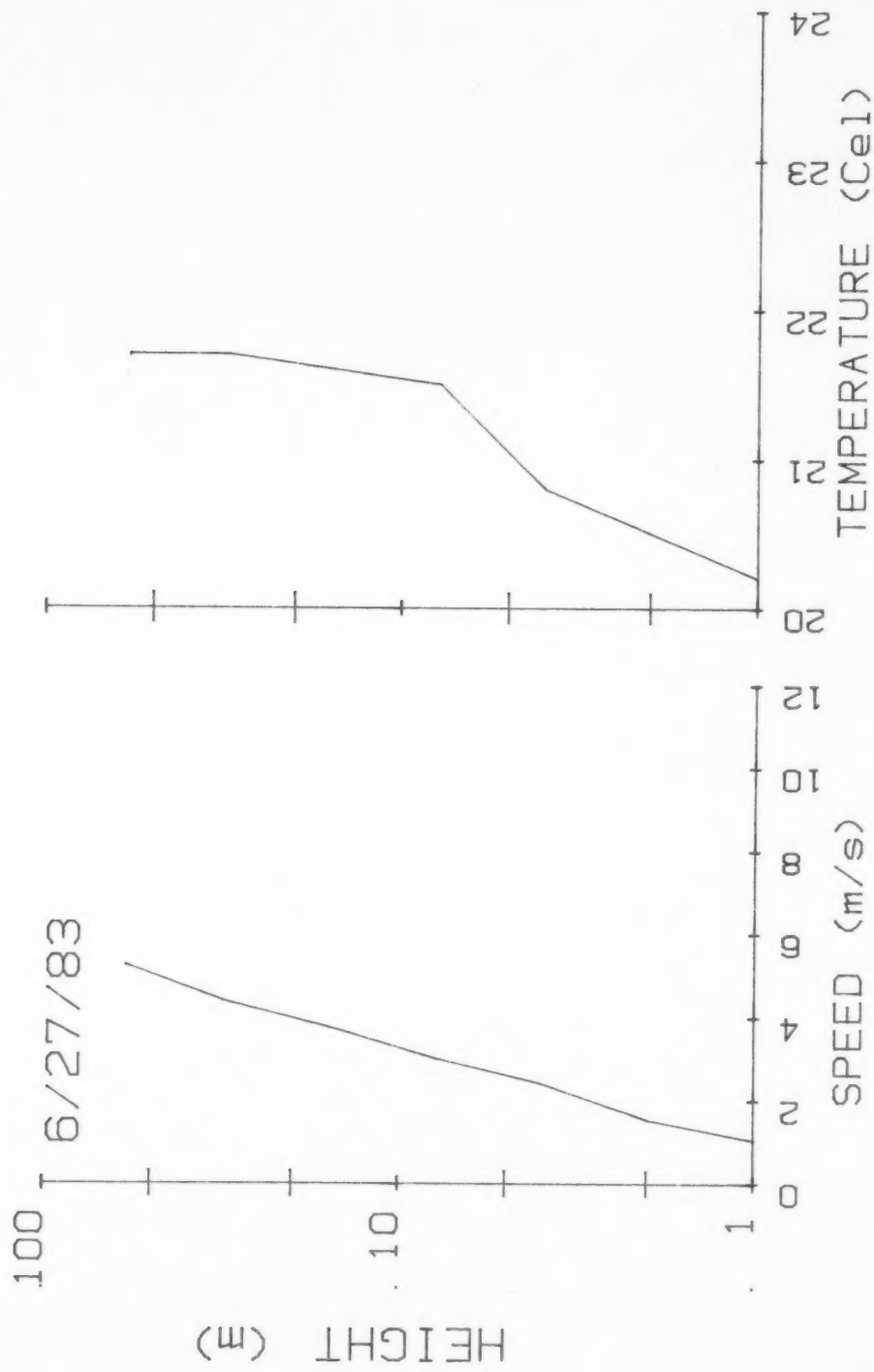


Figure B-21. Speed and temperature profiles for release of June 27, 1983.

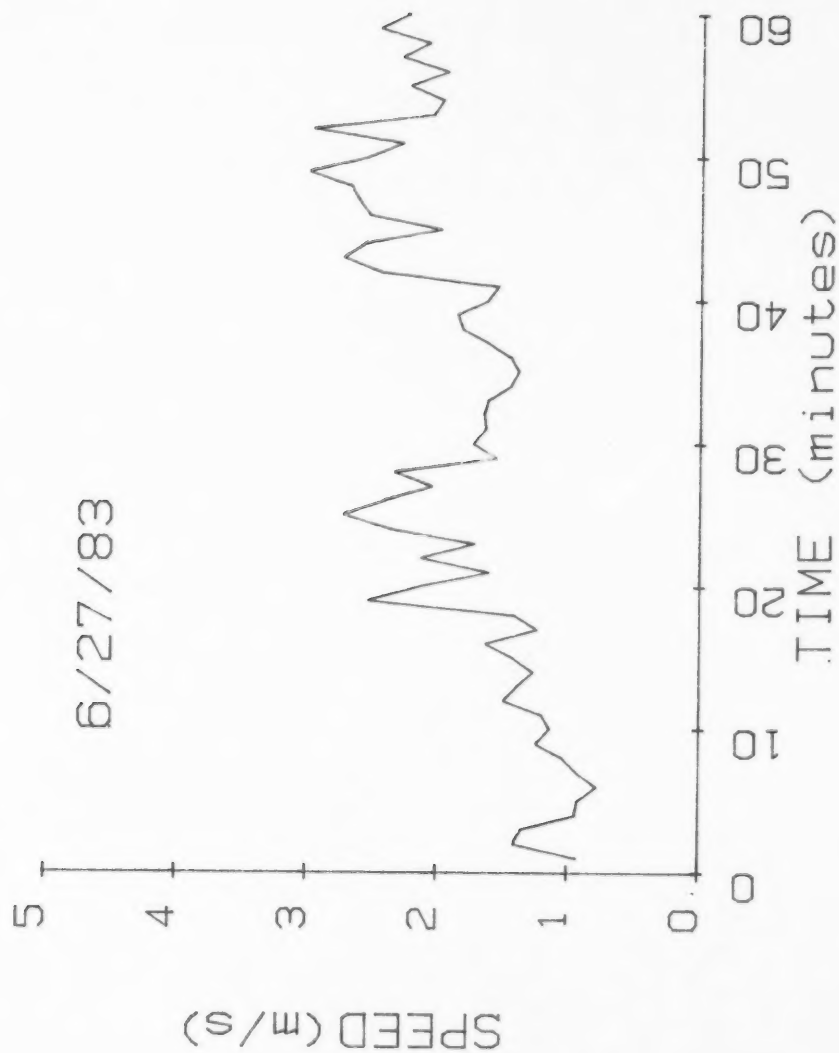


Figure B-22. Wind speed at 2 m on June 27, 1983.

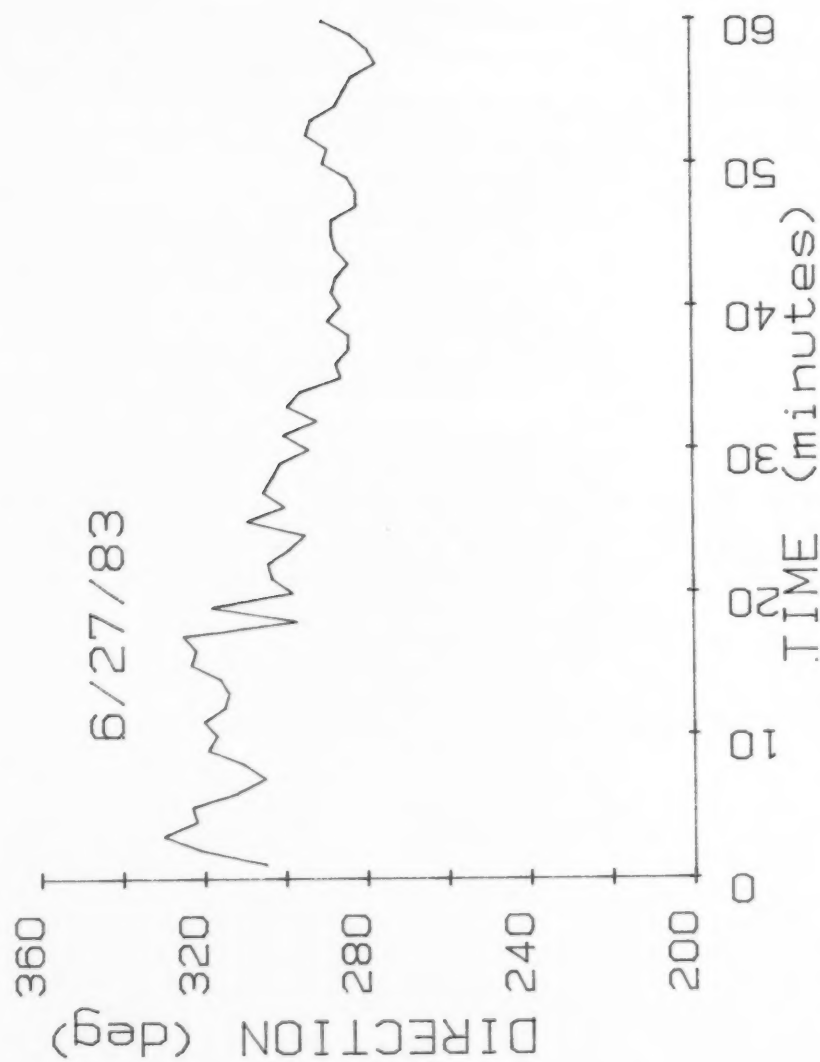


Figure B-23. Wind direction at 2 m on June 27, 1983.

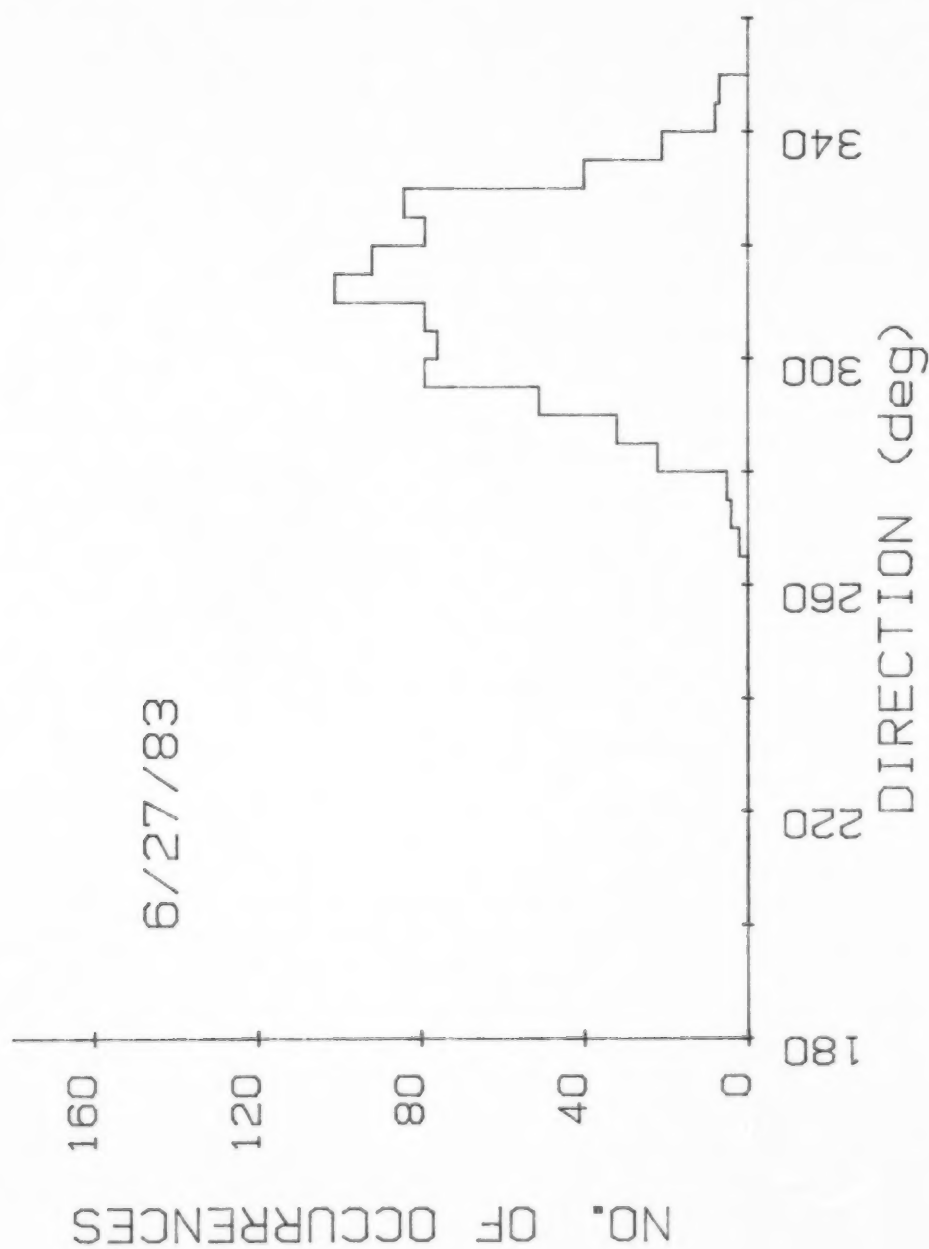


Figure B-24. Wind direction histogram for June 27, 1983.

APPENDIX C

TRACER CONCENTRATION DATA

This section contains the results obtained from six multiple tracer releases during May and June of 1983. For the ZnS results, the actual number of counts obtained with the Rankin counter is given for each filter exhibiting counts significantly above background levels. These counts have been converted to normalized exposure values, in units of seconds per cubic meter, using the procedure described in the body of this volume. For the SF₆ and chlorocarbon data, the concentrations in parts per trillion and parts per billion, respectively, are tabulated. Background values of 15 ppt have been subtracted from the SF₆ concentrations. The total pumping time for each sampling unit is also given, and the normalized exposure was determined as described in the main text. In the graphs of the ZnS and SF₆ concentration distributions, a small number of values have been interpolated in cases where such interpolations can be made with reasonable confidence. These points are clearly identified in each graph.

The chlorocarbon results at the are given first in a separate table that summarizes the results for the five releases during which organic tracers were used. Following this table, computer listings of the ZnS and SF₆ concentrations are given for all releases at all arcs. The ZnS and SF₆ results 1600-m towers follow. In many cases, only one of the two towers was crossed by the plume. Following these listings, a series of figures show the relative ZnS and SF₆ exposures at all the arcs.

CHLOROCARBON TRACER RESULTS

<u>Date/Tracer</u>	<u>Arc-azimuth</u>	<u>Concentration (ppb)</u>	<u>Time (sec)</u>	<u>Exposure (sec/m³)</u>
May 26, 1983 CC14	8-108	3.0	5460	1.04E-05
	8-120	4.0	5460	2.10E-05
	8-132	0.1	5460	5.25E-07
	16-114	0.4	5460	2.10E-06
	16-122	0.3	7200	2.08E-06
	32-113	0.2	7260	1.40E-06
June 5, 1983 CC14	8-108	0.7	5880	2.52E-06
	8-120	0.9	5880	3.24E-06
	16-106	0.2	5700	6.98E-07
	16-114	0.9	6360	3.50E-06
	32-113	0.4	6660	1.63E-06
June 12, 1983 CC14	8-108	11.8	5460	3.95E-05
	16-106	2.8	6300	1.08E-05
	16-114	0.4	6360	1.56E-06
	32-113	0.3	7440	1.37E-06
June 24, 1983 CH3CC13	8-72	8.0	5100	1.91E-05
	8-84	9.1	5040	2.15E-05
	8-96	2.7	4620	5.85E-06
	16-74	3.4	5760	9.19E-06
	16-82	3.1	5700	8.29E-06
	16-90	2.9	5640	7.68E-06
	16-98	0.6	5580	1.57E-06
	32-77	1.7	5220	4.16E-06
	32-89	1.0	5160	2.42E-06
June 27, 1983 CC14	8-84	0.4	6360	1.16E-06
	8-96	2.8	6300	8.02E-06
	8-108	0.4	6360	1.16E-06
	8-120	5.7	6120	1.59E-05
	8-132	0.1	6120	2.78E-07
	16-98	0.8	7500	2.73E-06
	16-106	0.3	7440	1.02E-06
	16-122	0.5	7260	1.65E-06
	16-130	0.2	7140	6.49E-07
	32-113	0.2	7500	6.82E-07
	32-125	0.1	7440	3.38E-07

DATE OF RELEASE : 5/18/83
ARC 100 M
AMOUNT OF ZnS RELEASED : 1062 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.80
FLOWRATE FOR FILTERS : 0.209E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
102	0	0.000E+00
104	183	0.135E-06
106	173	0.128E-06
108	185	0.137E-06
110	652	0.482E-06
112	1958	0.145E-05
114	5646	0.417E-05
116	16100	0.119E-04
118	44292	0.327E-04
120	85253	0.630E-04
122	196599	0.145E-03
124	246614	0.182E-03
126	555467	0.410E-03
128	751527	0.555E-03
130	647657	0.479E-03
132	720560	0.532E-03
134	737373	0.545E-03
136	597740	0.442E-03
138	352113	0.260E-03
140	65175	0.482E-04
142	53082	0.392E-04
144	22220	0.164E-04
146	10081	0.745E-05
148	4118	0.304E-05
150	1404	0.104E-05
152	560	0.414E-06
154	627	0.463E-06
156	95	0.702E-07
158	6	0.443E-08

DATE OF RELEASE : 5/18/83
 ARC 200 M
 AMOUNT OF ZnS RELEASED : 1062 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.80
 FLOWRATE FOR FILTERS : $0.211\text{E-}03 \text{ M}^3/\text{SEC}$

AZIMUTH	COUNTS	NORM. EXP(SEC/M ³)
104	44	0.322E-07
106	108	0.790E-07
108	56	0.410E-07
110	62	0.454E-07
112	49	0.359E-07
114	120	0.878E-07
116	551	0.403E-06
118	2598	0.190E-05
120	9504	0.696E-05
122	28374	0.208E-04
124	86032	0.630E-04
126	135215	0.990E-04
128	200027	0.146E-03
130	210020	0.154E-03
132	228082	0.167E-03
134	199300	0.146E-03
136	109992	0.805E-04
138	42680	0.312E-04
140	6610	0.484E-05
142	4617	0.338E-05
144	1345	0.984E-06
146	990	0.725E-06
148	349	0.255E-06
150	34	0.249E-07
152	5	0.366E-08
154	8	0.585E-08

DATE OF RELEASE : 5/18/83
ARC 800 M
AMOUNT OF ZnS RELEASED : 1062 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.81
FLOWRATE FOR FILTERS : 0.227E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
120	6	0.413E-08
122	184	0.127E-06
124	8128	0.560E-05
126	6315	0.435E-05
128	16770	0.116E-04
130	40920	0.282E-04
132	28178	0.194E-04
134	12952	0.892E-05
136	2462	0.170E-05
138	500	0.344E-06
140	0	0.000E+00

DATE OF RELEASE : 5/18/83
ARC 1600 M
AMOUNT OF ZnS RELEASED : 1062 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.82
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
121	7	0.478E-08
122	27	0.184E-07
123	39	0.266E-07
124	0	0.000E+00
125	459	0.313E-06
126	1690	0.115E-05
127	3511	0.240E-05
128	5796	0.395E-05
129	8594	0.586E-05
130	10042	0.685E-05
131	11647	0.795E-05
132	3765	0.257E-05
133	4061	0.277E-05
134	1626	0.111E-05
135	261	0.178E-06
136	24	0.164E-07
137	4	0.273E-08

DATE OF RELEASE : 5/18/83
 ARC 3200 M
 AMOUNT OF ZnS RELEASED : 1062 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.83
 FLOWRATE FOR FILTERS : 0.214E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
121	3 *	0.225E-08
122	3 *	0.225E-08
123	28 *	0.203E-07
124	88 +	0.655E-07
125	208 +	0.156E-06
126	564 +	0.422E-06
127	1416	0.106E-05
128	2757	0.206E-05
129	3205	0.240E-05
130	3058	0.229E-05
131	1919	0.143E-05
132	630	0.472E-06
133	75	0.563E-07
134	23	0.170E-07
135	24	0.177E-07
136	12	0.898E-08
137	5	0.374E-08

* engine out of gas,cold
 + vacuum on filter lines poor

DATE OF RELEASE : 5/18/83
ARC 100 M
AMOUNT OF SF6 RELEASED : 1633 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
108	0	0	0.000E+00
116	449	7850	0.141E-04
124	9855	7970	0.315E-03
132	19385	8030	0.623E-03
140	2715	8090	0.880E-04
148	66	8270	0.219E-05
156	0	0	0.000E+00

DATE OF RELEASE : 5/18/83
ARC 200 M
AMOUNT OF SF6 RELEASED : 1633 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
114	0	0	0.000E+00
118	123	5850	0.288E-05
122	1375	5850	0.322E-04
126	7715	5850	0.181E-03
130	13785	5850	0.323E-03
134	9405	5850	0.220E-03
138	2075	5850	0.486E-04
142	1325	5850	0.310E-04
146	43	5850	0.101E-05
150	0	0	0.000E+00

DATE OF RELEASE : 5/18/83
ARC 800 M
AMOUNT OF SF6 RELEASED : 1633 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
120	0	0	0.000E+00
124	67	6163	0.165E-05
128	897	6163	0.221E-04
132	1095	6163	0.270E-04
136	185	6163	0.457E-05
140	7	6163	0.173E-06
144	0	10103	0.000E+00

DATE OF RELEASE : 5/18/83
ARC 1600 M
AMOUNT OF SF6 RELEASED : 1633 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
122	0 *	0	0.000E+00
124	13	6650	0.346E-06
126	115	6650	0.306E-05
128	333	6188	0.825E-05
130	485	6650	0.129E-04
132	419	6650	0.112E-04
134	92	6650	0.245E-05
136	3	6650	0.799E-07
138	0	6650	0.000E+00
140	3	6650	0.799E-07
142	1	6650	0.266E-07
144	0	0	0.000E+00

* flat bag

DATE OF RELEASE : 5/18/83
ARC 3200 M
AMOUNT OF SF6 RELEASED : 1633 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
125	0 *	0	0.000E+00
128	169	7180	0.486E-05
131	116	7180	0.334E-05
134	0	0	0.000E+00

* flat bag

DATE OF RELEASE : 5/26/83
 ARC 100 M
 AMOUNT OF ZnS RELEASED : 842 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.93
 FLOWRATE FOR FILTERS : 0.209E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
86	20	0.217E-07
88	91	0.986E-07
90	922	0.999E-06
92	4211	0.456E-05
94	13919	0.151E-04
96	72621	0.787E-04
98	171722	0.186E-03
100	249602	0.270E-03
102	368909	0.400E-03
104	504050	0.546E-03
106	506022	0.548E-03
108	582920	0.632E-03
110	576115	0.624E-03
112	529706	0.574E-03
114	613749	0.665E-03
116	753749	0.817E-03
118	855948	0.927E-03
120	996718	0.108E-02
122	977808	0.106E-02
124	825911	0.895E-03
126	694078	0.752E-03
128	525858	0.570E-03
130	319690	0.346E-03
132	78178	0.847E-04
134	85504	0.926E-04
136	16993	0.184E-04
138	2998	0.325E-05
140	251	0.272E-06
142	50	0.542E-07
144	5	0.542E-08

DATE OF RELEASE : 5/26/83
 ARC 200 M
 AMOUNT OF ZnS RELEASED : 842 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.93
 FLOWRATE FOR FILTERS : 0.211E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP (SEC/M**3)
80	79	0.848E-07
82	38	0.408E-07
84	58	0.622E-07
86	73	0.783E-07
88	16	0.172E-07
90	48	0.515E-07
92	204	0.219E-06
94	1650	0.177E-05
96	3830	0.411E-05
98	17681	0.190E-04
100	60160	0.646E-04
102	149042	0.160E-03
104	128280	0.138E-03
106	166410	0.179E-03
108	159941	0.172E-03
110	113637	0.122E-03
112	124781	0.134E-03
114	182261	0.196E-03
116	207153	0.222E-03
118	257972	0.277E-03
120	366994	0.394E-03
122	339499	0.364E-03
124	314121	0.337E-03
126	224093	0.240E-03
128	120579	0.129E-03
130	46985	0.504E-04
132	12928	0.139E-04
134	1834	0.197E-05
136	367	0.394E-06
138	15	0.161E-07
140	71	0.762E-07
142	33	0.354E-07
144	72	0.773E-07

DATE OF RELEASE : 5/26/83
ARC 800 M
AMOUNT OF ZnS RELEASED : 842 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.93
FLOWRATE FOR FILTERS : $0.227\text{E-}03 \text{ M}^3/\text{SEC}$

AZIMUTH	COUNTS	NORM. EXP (SEC/M ³)
100	14	$0.140\text{E-}07$
102	188	$0.188\text{E-}06$
104	2639	$0.263\text{E-}05$
106	17491	$0.174\text{E-}04$
108	26984	$0.269\text{E-}04$
110	22477	$0.224\text{E-}04$
112	19209	$0.192\text{E-}04$
114	16386	$0.163\text{E-}04$
116	20129	$0.201\text{E-}04$
118	28031	$0.280\text{E-}04$
120	33507	$0.334\text{E-}04$
122	31441	$0.314\text{E-}04$
124	48899	$0.488\text{E-}04$
126	934	$0.932\text{E-}06$
128	104	$0.104\text{E-}06$
130	8	$0.798\text{E-}08$

DATE OF RELEASE : 5/26/83
ARC 1600 M
AMOUNT OF ZnS RELEASED : 842 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.94
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
105	23	0.227E-07
106	191	0.188E-06
107	1365	0.135E-05
108	5825	0.575E-05
109	10886	0.107E-04
110	9079	0.896E-05
111	8388	0.827E-05
112	7638	0.753E-05
113	5965 *	0.588E-05
114	4990 *	0.492E-05
115	4061 *	0.401E-05
116	5367 *	0.529E-05
117	5711 *	0.563E-05
118	11089	0.109E-04
119	14425	0.142E-04
120	10600	0.105E-04
121	6134	0.605E-05
122	3480	0.343E-05
123	2159	0.213E-05
124	655	0.646E-06
125	153	0.151E-06
126	7	0.691E-08

* Engine driving pumps for these filters was noted as being off when filters were collected. No note was made if engine was still warm, which would have indicated a recent failure and valid data. Comparison with SF6 results suggests data are valid.

DATE OF RELEASE : 5/26/83
 ARC 3200 M
 AMOUNT OF ZnS RELEASED : 842 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.95
 FLOWRATE FOR FILTERS : 0.214E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
107	15	0.162E-07
108	44	0.476E-07
109	261	0.282E-06
110	1557 *	0.168E-05
111	3513 *	0.380E-05
112	3151 *	0.341E-05
113	74 +	0.800E-07
114	32 +	0.346E-07
115	1822	0.197E-05
116	1977	0.214E-05
117	2924	0.316E-05
118	3663	0.396E-05
119	3310	0.358E-05
120	1755	0.190E-05
121	1535	0.166E-05
122	472	0.510E-06
123	231	0.250E-06
124	88	0.951E-07
125	26	0.281E-07
126	8	0.865E-08

* engine dead, warm
 + engine failure

DATE OF RELEASE : 5/26/83
ARC 100 M
AMOUNT OF SF6 RELEASED : 1043 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
68	4375	6300	0.173E-03
76	3085	6300	0.122E-03
84	1165	6300	0.460E-04
92	985	6300	0.389E-04
100	13485	6300	0.533E-03
108	17085	6240	0.668E-03
116	26185	6300	0.103E-02
124	26685	6300	0.105E-02
132	4985	6240	0.195E-03
140	0 *	0	0.000E+00

* flat bag

DATE OF RELEASE : 5/26/83
ARC 200 M
AMOUNT OF SF6 RELEASED : 1043 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
66	0	6060	0.000E+00
70	12	6120	0.460E-06
74	94	6120	0.361E-05
78	496	6120	0.190E-04
82	668	6120	0.256E-04
86	0 *	6120	0.000E+00
90	1495	6120	0.574E-04
94	1575	6120	0.604E-04
98	3065	6120	0.118E-03
102	7685	5940	0.286E-03
106	5655	5940	0.211E-03
110	5335	5880	0.197E-03
114	7365	5820	0.269E-03
118	5655	5880	0.208E-03
122	263 +	0	0.000E+00
126	6555	5760	0.237E-03
130	1495	5720	0.536E-04
134	40	5640	0.141E-05
138	0	5640	0.000E+00

* missing sample
+ flat bag

DATE OF RELEASE : 5/26/83
ARC 800 M
AMOUNT OF SF6 RELEASED : 1043 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
96	0	5520	0.000E+00
100	50	5460	0.171E-05
104	316	5520	0.109E-04
108	1435	5460	0.491E-04
112	1035	5520	0.358E-04
116	1105	5520	0.382E-04
120	2255	5460	0.772E-04
124	533	5520	0.184E-04
128	4	5520	0.138E-06
132	0	5460	0.000E+00

DATE OF RELEASE : 5/26/83

ARC 1600 M

AMOUNT OF SF6 RELEASED : 1043 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
90	0	0	0.000E+00
92	2	5520	0.692E-07
94	6	5460	0.205E-06
96	6	5520	0.208E-06
98	0	5520	0.000E+00
100	2	5460	0.685E-07
102	2	5400	0.677E-07
104	3	5460	0.103E-06
106	63	5460	0.216E-05
108	196 *	5460	0.671E-05
110	715	5520	0.247E-04
112	515	5460	0.176E-04
114	417	5460	0.143E-04
116	387 *	7320	0.178E-04
118	605	7200	0.273E-04
120	605	7140	0.271E-04
122	316	7200	0.143E-04
124	43	6360	0.171E-05
126	131	6240	0.513E-05
128	0	6120	0.000E+00
130	27	6000	0.102E-05
132	2	5940	0.745E-07
134	6	5880	0.221E-06
136	0	5820	0.000E+00
138	38	5880	0.140E-05
140	2	5700	0.715E-07
142	10	5700	0.357E-06
144	0	0	0.000E+00
146	0	0	0.000E+00

* flat bag

DATE OF RELEASE : 5/26/83
ARC 3200 M
AMOUNT OF SF6 RELEASED : 1043 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
71	7	9360	0.411E-06
74	7	9240	0.406E-06
77	70	9060	0.398E-05
80	0	8880	0.000E+00
83	6	8700	0.327E-06
86	269 *	8520	0.144E-04
89	27	8400	0.142E-05
92	31	8220	0.160E-05
95	4	8100	0.203E-06
98	4	7800	0.196E-06
101	18	7680	0.867E-06
104	6	7560	0.284E-06
107	6	7440	0.280E-06
110	137	7320	0.629E-05
113	151	7260	0.687E-05
116	191	7260	0.869E-05
119	183	7200	0.826E-05
122	40	7200	0.181E-05
125	5	7200	0.226E-06
128	6	7200	0.271E-06
131	0	7200	0.000E+00

* flat bag

DATE OF RELEASE : 6/5/83
 ARC 100 M
 AMOUNT OF ZnS RELEASED : 792 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.89
 FLOWRATE FOR FILTERS : 0.209E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
86	302	0.333E-06
88	139	0.153E-06
90	141	0.155E-06
92	861	0.949E-06
94	1420	0.157E-05
96	6052	0.667E-05
98	15076	0.166E-04
100	28215	0.311E-04
102	48557	0.535E-04
104	119660	0.132E-03
106	175522	0.193E-03
108	334773	0.369E-03
110	489174	0.539E-03
112	575474	0.634E-03
114	582084	0.642E-03
116	797591	0.879E-03
118	585797	0.646E-03
120	590196	0.651E-03
122	452364	0.499E-03
124	331052	0.365E-03
126	239854	0.264E-03
128	131242	0.145E-03
130	73094	0.806E-04
132	37111	0.409E-04
134	19385	0.214E-04
136	6152	0.678E-05
138	1646	0.181E-05
140	105	0.116E-06
142	38	0.419E-07
144	126	0.139E-06
146	60	0.661E-07
148	92	0.101E-06
150	45	0.496E-07
152	66	0.727E-07
154	101	0.111E-06
156	93	0.103E-06
158	123	0.136E-06

DATE OF RELEASE : 6/5/83
 ARC 200 M
 AMOUNT OF ZnS RELEASED : 792 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.89
 FLOWRATE FOR FILTERS : 0.211E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP (SEC/M**3)
94	97	0.106E-06
96	280	0.306E-06
98	979	0.107E-05
100	3828	0.418E-05
102	10393	0.113E-04
104	16853	0.184E-04
106	30023	0.328E-04
108	73044	0.797E-04
110	108456	0.118E-03
112	178646	0.195E-03
114	201087	0.220E-03
116	238040	0.260E-03
118	233522	0.255E-03
120	174266	0.190E-03
122	103693	0.113E-03
124	78858	0.861E-04
126	43283	0.473E-04
128	21557	0.235E-04
130	5196	0.567E-05
132	1302	0.142E-05
134	258	0.282E-06

DATE OF RELEASE : 6/5/83
ARC 800 M
AMOUNT OF ZnS RELEASED : 792 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.90
FLOWRATE FOR FILTERS : 0.227E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
102	114	0.117E-06
104	900	0.924E-06
106	5136	0.527E-05
108	6426	0.659E-05
110	7237	0.743E-05
112	10860	0.111E-04
114	17878	0.183E-04
116	24563	0.252E-04
118	17746	0.182E-04
120	7391	0.758E-05
122	3607	0.370E-05
124	4661	0.478E-05
126	81	0.831E-07

DATE OF RELEASE : 6/5/83
ARC 1600 M
AMOUNT OF ZnS RELEASED : 792 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.90
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
104	59	0.592E-07
105	253	0.254E-06
106	984	0.988E-06
107	1935	0.194E-05
108	2425	0.243E-05
109	2326	0.234E-05
110	2491	0.250E-05
111	2468	0.248E-05
112	4026	0.404E-05
113	4622	0.464E-05
114	7058	0.709E-05
115	7191	0.722E-05
116	5099	0.512E-05
117	3545	0.356E-05
118	1532	0.154E-05
119	1051	0.106E-05
120	294	0.295E-06
121	74	0.743E-07

DATE OF RELEASE : 6/5/83
ARC 3200 M
AMOUNT OF ZnS RELEASED : 792 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.91
FLOWRATE FOR FILTERS : 0.214E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
107	239	0.263E-06
108	641	0.706E-06
109	890	0.980E-06
110	728	0.801E-06
111	1177	0.130E-05
112	2526	0.278E-05
113	152 *	0.167E-06
114	50 *	0.550E-07
115	1041	0.115E-05
116	320	0.352E-06
117	81	0.892E-07
118	50	0.550E-07

* engine failure

DATE OF RELEASE : 6/5/83
ARC 100 M
AMOUNT OF SF6 RELEASED : 1293 GM

AZIMUTH	CONC (PPT)	TIME (SEC)	EXPOSURE (SEC/M**3)
84	0	0	0.000E+00
92	138	5100	0.356E-05
100	3205	5040	0.817E-04
108	14835	5100	0.383E-03
116	37985	5040	0.968E-03
124	17685	5100	0.456E-03
132	1935	5040	0.493E-04
140	4	5040	0.102E-06
148	0	5040	0.000E+00

DATE OF RELEASE : 6/5/83
ARC 200 M
AMOUNT OF SF6 RELEASED : 1293 GM

AZIMUTH	CONC (PPT)	TIME (SEC)	EXPOSURE (SEC/M**3)
86	0	0	0.000E+00
90	2	4320	0.437E-07
94	6	4380	0.133E-06
98	197	4500	0.448E-05
102	769	4500	0.175E-04
106	4165	4620	0.973E-04
110	8985	4620	0.210E-03
114	14385	4800	0.349E-03
118	14685	4800	0.357E-03
122	7505	4920	0.187E-03
126	2545	4920	0.633E-04
130	351	5100	0.905E-05
134	2	5100	0.516E-07
138	0	0	0.000E+00

DATE OF RELEASE : 6/5/83
ARC 800 M
AMOUNT OF SF6 RELEASED : 1293 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
96	0	0	0.000E+00
100	0	0	0.000E+00
104	70	5940	0.210E-05
108	498	5880	0.148E-04
112	744	5940	0.224E-04
116	1455	5880	0.433E-04
120	532	5880	0.158E-04
124	50	5880	0.149E-05
128	200	5880	0.595E-05
132	0	5940	0.000E+00

DATE OF RELEASE : 6/5/83
ARC 1600 M
AMOUNT OF SF6 RELEASED : 1293 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
102	0	0	0.000E+00
104	4	5520	0.112E-06
106	104	5700	0.300E-05
108	227	6180	0.710E-05
110	172	6240	0.543E-05
112	278	6300	0.886E-05
114	555	6360	0.179E-04
116	389	6420	0.126E-04
118	115	6480	0.377E-05
120	15	6540	0.496E-06
122	0	0	0.000E+00

DATE OF RELEASE : 6/5/83
ARC 3200 M
AMOUNT OF SF6 RELEASED : 1293 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
104	0	0	0.000E+00
107	15	6720	0.510E-06
110	100	6600	0.334E-05
113	188	6660	0.633E-05
116	15	6660	0.505E-06
119	0	0	0.000E+00

DATE OF RELEASE : 6/12/83
 ARC 100 M
 AMOUNT OF ZnS RELEASED : 840 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.92
 FLOWRATE FOR FILTERS : 0.209E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
68	103	0.111E-06
70	80	0.859E-07
72	53	0.569E-07
74	78	0.838E-07
76	52	0.559E-07
78	41	0.440E-07
80	446	0.479E-06
82	2722	0.292E-05
84	2340	0.251E-05
86	17506	0.188E-04
88	66492	0.714E-04
90	176157	0.189E-03
92	172109	0.185E-03
94	590419	0.634E-03
96	651386	0.700E-03
98	579549	0.623E-03
100	529893	0.569E-03
102	637834	0.685E-03
104	799062	0.858E-03
106	868724	0.933E-03
108	1123771	0.121E-02
110	1375128	0.148E-02
112	1167443	0.125E-02
114	909491	0.977E-03
116	645846	0.694E-03
118	332915	0.358E-03
120	214314	0.230E-03
122	63017	0.677E-04
124	17705	0.190E-04
126	3669	0.394E-05
128	482	0.518E-06
130	68	0.731E-07
132	59	0.634E-07
134	114	0.122E-06

DATE OF RELEASE : 6/12/83

ARC 200 M

AMOUNT OF ZnS RELEASED : 840 GM

NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.92

FLOWRATE FOR FILTERS : $0.211\text{E-}03 \text{ M}^3/\text{SEC}$

AZIMUTH	COUNTS	NORM. EXP (SEC/M ³)
86	370	$0.394\text{E-}06$
88	5441	$0.579\text{E-}05$
90	29144	$0.310\text{E-}04$
92	124114	$0.132\text{E-}03$
94	229096	$0.244\text{E-}03$
96	206785	$0.220\text{E-}03$
98	191573	$0.204\text{E-}03$
100	172144	$0.183\text{E-}03$
102	217637	$0.232\text{E-}03$
104	385046	$0.410\text{E-}03$
106	208711 *	$0.222\text{E-}03$
108	450128	$0.479\text{E-}03$
110	412635	$0.439\text{E-}03$
112	374349	$0.398\text{E-}03$
114	230562	$0.245\text{E-}03$
116	145293	$0.155\text{E-}03$
118	64693	$0.688\text{E-}04$
120	20452	$0.218\text{E-}04$
122	3194	$0.340\text{E-}05$
124	423	$0.450\text{E-}06$

* dirty filter

DATE OF RELEASE : 6/12/83
ARC 800 M
AMOUNT OF ZnS RELEASED : 840 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.93
FLOWRATE FOR FILTERS : $0.227\text{E-03 M}^3/\text{SEC}$

AZIMUTH	COUNTS	NORM. EXP (SEC/M ³)
98	183 *	0.183E-06
100	898 *	0.898E-06
102	60028	0.600E-04
104	40454	0.404E-04
106	43214	0.432E-04
108	39599	0.396E-04
110	40841	0.408E-04
112	32209	0.322E-04
114	12396	0.124E-04
116	1720	0.172E-05
118	92	0.920E-07

* engine failure ?

DATE OF RELEASE : 6/12/83
ARC 1600 M
AMOUNT OF ZnS RELEASED : 840 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.93
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
99	20	0.196E-07
100	360	0.352E-06
101	1437	0.141E-05
102	5504	0.538E-05
103	12223	0.120E-04
104	4328	0.423E-05
105	19253	0.188E-04
106	12922	0.126E-04
107	15227	0.149E-04
108	18053	0.177E-04
109	15120	0.148E-04
110	17670	0.173E-04
111	17497	0.171E-04
112	10564	0.103E-04
113	3706	0.363E-05
114	1492	0.146E-05
115	529	0.518E-06
116	156	0.153E-06
117	30	0.293E-07

DATE OF RELEASE : 6/12/83
ARC 3200 M
AMOUNT OF ZnS RELEASED : 840 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.94
FLOWRATE FOR FILTERS : 0.214E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
101	29	0.311E-07
102	157	0.168E-06
103	1138	0.122E-05
104	28 *	0.300E-07
105	84 *	0.900E-07
106	31 *	0.332E-07
107	6407	0.687E-05
108	6162	0.661E-05
109	6717	0.720E-05
110	6916	0.741E-05
111	5613	0.602E-05
112	3771	0.404E-05
113	2173	0.233E-05
114	1164	0.125E-05
115	667	0.715E-06
116	234	0.251E-06
117	102	0.109E-06
118	19	0.204E-07
119	24	0.257E-07

* engine failure

DATE OF RELEASE : 6/12/83
ARC 100 M
AMOUNT OF SF6 RELEASED : 1134 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
68	11	5340	0.339E-06
76	0	5340	0.000E+00
84	1385	5340	0.427E-04
92	24985	5340	0.769E-03
100	43385	5400	0.135E-02
108	111985	4860	0.314E-02
116	40285	5400	0.125E-02
124	378	5400	0.118E-04
132	0	5460	0.000E+00

DATE OF RELEASE : 6/12/83
ARC 200 M
AMOUNT OF SF6 RELEASED : 1134 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
74	0	5040	0.000E+00
78	4	5100	0.118E-06
82	19	5100	0.559E-06
86	88	5100	0.259E-05
90	3085	5100	0.907E-04
94	12485	5100	0.367E-03
98	12585	4980	0.361E-03
102	14585	5040	0.424E-03
106	31585	4980	0.907E-03
110	31285	5040	0.909E-03
114	16285	4980	0.468E-03
118	2875	5040	0.836E-04
122	109	4980	0.313E-05
126	0	5040	0.000E+00
130	2	5040	0.581E-07
134	0	5100	0.000E+00

DATE OF RELEASE : 6/12/83
ARC 800 M
AMOUNT OF SF6 RELEASED : 1134 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
92	0	0	0.000E+00
96	8	5460	0.252E-06
100	2395	5400	0.746E-04
104	3005	5400	0.936E-04
108	3805	5460	0.120E-03
112	2195	5460	0.691E-04
116	69	5520	0.220E-05
120	0	0	0.000E+00

DATE OF RELEASE : 6/12/83
ARC 1600 M
AMOUNT OF SF6 RELEASED : 1134 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
98	0	0	0.000E+00
100	23 *	6420	0.852E-06
102	388	6300	0.141E-04
104	1225	6360	0.449E-04
106	1025	6300	0.372E-04
108	1365	6360	0.501E-04
110	1625	6360	0.596E-04
112	667	6300	0.242E-04
114	100	6360	0.367E-05
116	1	6300	0.363E-07
118	0	6300	0.000E+00

* bag nearly flat

DATE OF RELEASE : 6/12/83

ARC 3200 M

AMOUNT OF SF6 RELEASED : 1134 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
101	0	0	0.000E+00
104	212	6540	0.800E-05
107	543	6480	0.203E-04
110	0 *	0	0.000E+00
113	127	6840	0.501E-05
116	25 +	6840	0.986E-06
119	0	0	0.000E+00

* flat bag

+ bag nearly flat

DATE OF RELEASE : 6/24/83
 ARC 100 M
 AMOUNT OF ZnS RELEASED : 634 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.95
 FLOWRATE FOR FILTERS : 0.209E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
68	23856 *	0.351E-04
70	36711 *	0.540E-04
72	25032 *	0.368E-04
74	41795 *	0.614E-04
76	21051 *	0.309E-04
78	31501 *	0.463E-04
80	960350	0.141E-02
82	681368 +	0.100E-02
84	598902 +	0.880E-03
86	570468	0.838E-03
88	330253	0.485E-03
90	238322	0.350E-03
92	210799	0.310E-03
94	45319	0.666E-04
96	14532	0.214E-04
98	6182	0.909E-05
100	1668	0.245E-05
102	499	0.733E-06
104	168	0.247E-06
106	212	0.312E-06

* engine failure
 + dirty filter

DATE OF RELEASE : 6/24/83

ARC 200 M

AMOUNT OF ZnS RELEASED : 634 GM

NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.95

FLOWRATE FOR FILTERS : $0.211\text{E-}03 \text{ M}^3/\text{SEC}$

AZIMUTH	COUNTS	NORM. EXP (SEC/M ³)
68	157513	0.229E-03
70	193126	0.281E-03
72	223610	0.326E-03
74	287363	0.418E-03
76	308621	0.449E-03
78	337541	0.491E-03
80	347093	0.505E-03
82	400786	0.583E-03
84	293981	0.428E-03
86	147035	0.214E-03
88	87659	0.128E-03
90	40841	0.595E-04
92	20170	0.294E-04
94	5060	0.737E-05
96	1496	0.218E-05
98	540	0.786E-06
100	746	0.109E-05
102	410	0.597E-06
104	215	0.313E-06

DATE OF RELEASE : 6/24/83
ARC 800 M
AMOUNT OF ZnS RELEASED : 634 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.96
FLOWRATE FOR FILTERS : 0.227E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
70	310 *	0.424E-06
72	369 *	0.505E-06
74	246 *	0.336E-06
76	169 *	0.231E-06
78	638 *	0.872E-06
80	22919	0.313E-04
82	21078	0.288E-04
84	19379	0.265E-04
86	19072	0.261E-04
88	9103	0.124E-04
90	3910	0.535E-05
92	1094	0.150E-05
94	335	0.458E-06
96	82	0.112E-06

* engine failure ?

DATE OF RELEASE : 6/24/83
 ARC 1600 M
 AMOUNT OF ZnS RELEASED : 634 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.96
 FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
70	60 *	0.803E-07
71	40 *	0.535E-07
72	119 *	0.159E-06
73	24 *	0.321E-07
74	86 *	0.115E-06
75	5251	0.703E-05
76	5069	0.678E-05
77	5693	0.762E-05
78	5629	0.753E-05
79	5524	0.739E-05
80	4463	0.597E-05
81	5665	0.758E-05
82	4904	0.656E-05
83	2982	0.399E-05
84	2153	0.288E-05
85	3077	0.412E-05
86	2321	0.311E-05
87	2960	0.396E-05
88	2198	0.294E-05
89	1805	0.242E-05
90	16 +	0.214E-07
91	15 +	0.201E-07
92	17 +	0.227E-07
93	14 +	0.187E-07
94	542	0.725E-06
95	511	0.684E-06
96	204	0.273E-06
97	143	0.191E-06
98	144	0.193E-06
99	88	0.118E-06
100	88	0.118E-06

* engine failure
 + engine failure ?

DATE OF RELEASE : 6/24/83
 ARC 3200 M
 AMOUNT OF ZnS RELEASED : 634 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.97
 FLOWRATE FOR FILTERS : 0.214E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
71	763	0.112E-05
72	905	0.133E-05
73	1076	0.158E-05
74	1388	0.203E-05
75	1326	0.194E-05
76	1845	0.270E-05
77	1832	0.269E-05
78	2044	0.300E-05
79	2188	0.321E-05
80	7 *	0.103E-07
81	2319	0.340E-05
82	2304	0.338E-05
83	2097	0.307E-05
84	1761	0.258E-05
85	1663	0.244E-05
86	1257	0.184E-05
87	1099	0.161E-05
88	964	0.141E-05
89	970	0.142E-05
90	669	0.981E-06
91	600	0.879E-06
92	454	0.665E-06
93	439	0.643E-06
94	343	0.503E-06
95	208	0.305E-06
96	180	0.264E-06
97	223	0.327E-06
98	191	0.280E-06
99	121	0.177E-06
100	125	0.183E-06
101	56	0.821E-07
102	53	0.777E-07
103	39	0.572E-07

* filter not exposed ?

DATE OF RELEASE : 6/24/83
ARC 100 M
AMOUNT OF SF6 RELEASED : 930 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
68	58985	3780	0.157E-02
76	78985	3720	0.207E-02
84	63985	3660	0.165E-02
92	6155	3660	0.158E-03
100	43	3540	0.107E-05
108	16	3480	0.392E-06
116	14	3420	0.337E-06
124	0	0	0.000E+00

DATE OF RELEASE : 6/24/83
ARC 200 M
AMOUNT OF SF6 RELEASED : 930 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
66	10685	4080	0.307E-03
70	11485	4140	0.334E-03
74	18885	4260	0.566E-03
78	20885	4560	0.670E-03
82	22185	4800	0.749E-03
86	6225	4920	0.215E-03
90	1875	5220	0.688E-04
94	281	5280	0.104E-04
98	18	5400	0.684E-06
102	6	5640	0.238E-06
106	2	5760	0.810E-07
110	6	5840	0.246E-06
114	0	0	0.000E+00

DATE OF RELEASE : 6/24/83
ARC 800 M
AMOUNT OF SF6 RELEASED : 930 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
68	1035	5040	0.367E-04
72	492	5100	0.176E-04
76	585	4980	0.205E-04
80	1605	5040	0.569E-04
84	1575	5040	0.558E-04
88	686	5100	0.246E-04
92	79	5040	0.280E-05
96	0	5100	0.000E+00
100	44	5040	0.156E-05
104	56	5040	0.198E-05
108	0 *	5100	0.000E+00
112	56	5040	0.198E-05
116	0	0	0.000E+00

* missing sample

DATE OF RELEASE : 6/24/83
ARC 1600 M
AMOUNT OF SF6 RELEASED : 930 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
70	258	5760	0.105E-04
72	297	5760	0.120E-04
74	495	5760	0.201E-04
76	551	5760	0.223E-04
78	503	5700	0.202E-04
80	433	5700	0.174E-04
82	409	5700	0.164E-04
84	143	5640	0.567E-05
86	186	5640	0.738E-05
88	141	5640	0.559E-05
90	95	5640	0.377E-05
92	38	5580	0.149E-05
94	40	5520	0.155E-05
96	19	5580	0.746E-06
98	0	5580	0.000E+00
100	7	5520	0.272E-06
102	0 *	5520	0.000E+00
104	2	5460	0.768E-07
106	0	5460	0.000E+00

* missing sample

DATE OF RELEASE : 6/24/83
ARC 3200 M
AMOUNT OF SF6 RELEASED : 930 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
71	81	5220	0.297E-05
74	129	5220	0.474E-05
77	196	5220	0.719E-05
80	235	5220	0.863E-05
83	172	5220	0.631E-05
86	110	5220	0.404E-05
89	59	5160	0.214E-05
92	47	5160	0.171E-05
95	19	5220	0.697E-06
98	7	5220	0.257E-06
101	0 *	5220	0.000E+00

* missing sample

DATE OF RELEASE : 6/27/83
 ARC 100 M
 AMOUNT OF ZnS RELEASED : 822 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.89
 FLOWRATE FOR FILTERS : 0.209E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
68	2845 *	0.302E-05
70	4686 *	0.498E-05
72	9774 *	0.104E-04
74	5113 *	0.543E-05
76	9019 *	0.958E-05
78	10940 *	0.116E-04
80	24732 *	0.263E-04
82	15803 *	0.168E-04
84	11425 *	0.121E-04
86	34193 *	0.363E-04
88	34169 *	0.363E-04
90	103861 *	0.110E-03
92	54051 *	0.574E-04
94	44249 *	0.470E-04
96	1128454	0.120E-02
98	1025883	0.109E-02
100	984774	0.105E-02
102	1042622	0.111E-02
104	890070	0.945E-03
106	767575	0.815E-03
108	671630	0.713E-03
110	519730	0.552E-03
112	510574	0.542E-03
114	389245	0.413E-03
116	408477	0.434E-03
118	352294	0.374E-03
120	285852	0.304E-03
122	304132	0.323E-03
124	231620	0.246E-03
126	143597	0.153E-03
128	32076	0.341E-04
130	7354	0.781E-05
132	2604	0.277E-05
134	999	0.106E-05
136	167	0.177E-06

* engine failure

DATE OF RELEASE : 6/27/83
 ARC 200 M
 AMOUNT OF ZnS RELEASED : 822 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.89
 FLOWRATE FOR FILTERS : 0.211E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
68	3489	0.367E-05
70	8565	0.901E-05
72	23710	0.249E-04
74	34978	0.368E-04
76	51185	0.538E-04
78	62584	0.658E-04
80	87982	0.926E-04
82	142141	0.150E-03
84	177127	0.186E-03
86	247782	0.261E-03
88	130889	0.138E-03
90	205774	0.216E-03
92	237665	0.250E-03
94	214807	0.226E-03
96	126374 *	0.133E-03
98	48612 *	0.511E-04
100	187009	0.197E-03
102	152102	0.160E-03
104	101868 *	0.107E-03
106	215222	0.226E-03
108	257238	0.271E-03
110	244152	0.257E-03
112	222011	0.234E-03
114	169194	0.178E-03
116	126094	0.133E-03
118	137079	0.144E-03
120	152373	0.160E-03
122	87047	0.916E-04
124	61127	0.643E-04
126	25192	0.265E-04
128	2753	0.290E-05
130	385	0.405E-06
132	161	0.169E-06

* dirty filter

DATE OF RELEASE : 6/27/83
 ARC 800 M
 AMOUNT OF ZnS RELEASED : 822 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.90
 FLOWRATE FOR FILTERS : 0.227E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
70	17	0.168E-07
72	7	0.692E-08
74	61	0.603E-07
76	135	0.133E-06
78	888	0.878E-06
80	0 *	0.000E+00
82	1628	0.161E-05
84	2928	0.290E-05
86	6634	0.656E-05
88	13818	0.137E-04
90	17822	0.176E-04
92	19380	0.192E-04
94	19465	0.192E-04
96	14147	0.140E-04
98	12926	0.128E-04
100	12670	0.125E-04
102	7124	0.704E-05
104	4829	0.477E-05
106	6110	0.604E-05
108	5951	0.588E-05
110	6057	0.599E-05
112	9442	0.934E-05
114	13061	0.129E-04
116	13231	0.131E-04
118	17908	0.177E-04
120	16842	0.167E-04
122	17635	0.174E-04
124	91795 +	0.908E-04
126	7487	0.740E-05
128	1060	0.105E-05
130	46	0.455E-07

* missing sample

+ no explanation for anomalously high value

DATE OF RELEASE : 6/27/83
 ARC 1600 M
 AMOUNT OF ZnS RELEASED : 822 GM
 NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.90
 FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
84	13 *	0.126E-07
85	62 *	0.600E-07
86	280 *	0.271E-06
87	647 *	0.626E-06
88	1527 *	0.148E-05
89	2609	0.252E-05
90	3988	0.386E-05
91	3917	0.379E-05
92	3515	0.340E-05
93	4020	0.389E-05
94	3938	0.381E-05
95	3173	0.307E-05
96	3383	0.327E-05
97	3060	0.296E-05
98	3329	0.322E-05
99	4222	0.408E-05
100	4048	0.392E-05
101	2840	0.275E-05
102	2248	0.217E-05
103	3481	0.337E-05
104	1041	0.101E-05
105	2238	0.217E-05
106	1064 +	0.103E-05
107	1480	0.143E-05
108	1248	0.121E-05
109	1076	0.104E-05
110	1149	0.111E-05
111	1181	0.114E-05
112	979	0.947E-06
113	928	0.898E-06
114	982	0.950E-06
115	1165	0.113E-05
116	1285	0.124E-05
117	1533	0.148E-05
118	1220	0.118E-05
119	1961	0.190E-05
120	2686	0.260E-05
121	3343	0.323E-05
122	2750	0.266E-05
123	3477	0.336E-05
124	2201	0.213E-05
125	1679	0.162E-05
126	561	0.543E-06
127	359	0.347E-06
128	79	0.764E-07

* engine failure ?

+ dirty filter

DATE OF RELEASE : 6/27/83
ARC 3200 M
AMOUNT OF ZnS RELEASED : 822 GM
NON-ISOKINETIC FLOW CORRECTION FACTOR : 0.91
FLOWRATE FOR FILTERS : 0.214E-03 M**3/SEC

AZIMUTH	COUNTS	NORM. EXP(SEC/M**3)
89	16	0.170E-07
90	20	0.212E-07
91	104	0.110E-06
92	396	0.420E-06
93	589	0.625E-06
94	604	0.641E-06
95	684	0.725E-06
96	629	0.667E-06
97	713	0.756E-06
98	474	0.503E-06
99	489	0.519E-06
100	528	0.560E-06
101	432	0.458E-06
102	637	0.676E-06
103	600	0.636E-06
104	532	0.564E-06
105	821	0.871E-06
106	697	0.739E-06
107	684	0.725E-06
108	825	0.875E-06
109	699	0.741E-06
110	722	0.766E-06
111	790	0.838E-06
112	927	0.983E-06
113	667	0.707E-06
114	739	0.784E-06
115	507	0.538E-06
116	444	0.471E-06
117	406	0.431E-06
118	423	0.449E-06
119	603	0.639E-06
120	628	0.666E-06
121	605	0.642E-06
122	487	0.516E-06
123	459	0.487E-06
124	540	0.573E-06
125	273	0.290E-06
126	525	0.557E-06
127	58	0.615E-07
128	63	0.668E-07
129	5	0.530E-08
130	10	0.106E-07

DATE OF RELEASE : 6/27/83

ARC 100 M

AMOUNT OF SF6 RELEASED : 1087 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
68	4085	5820	0.143E-03
76	6375	5760	0.221E-03
84	34285	5700	0.118E-02
92	45885	5700	0.157E-02
100	41685	5700	0.143E-02
108	24485	5700	0.840E-03
116	20485	5700	0.703E-03
124	9065	5640	0.308E-03
132	113	5640	0.383E-05
140	21	5580	0.705E-06
148	12	5580	0.403E-06
156	0	0	0.000E+00

DATE OF RELEASE : 6/27/83
ARC 200 M
AMOUNT OF SF6 RELEASED : 1087 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
66	137	4980	0.410E-05
70	655	4920	0.194E-04
74	2515	4980	0.754E-04
78	3885	5940	0.139E-03
82	7575	5880	0.268E-03
86	11085	5880	0.392E-03
90	18685	5880	0.661E-03
94	19385	5820	0.679E-03
98	10585	5820	0.371E-03
102	9615	5820	0.337E-03
106	10685	5880	0.378E-03
110	9145	5880	0.324E-03
114	8435	5820	0.295E-03
118	7485	5820	0.262E-03
122	4225	5820	0.148E-03
126	605	5820	0.212E-04
130	0	5760	0.000E+00
134	1	5760	0.347E-07
138	0	0	0.000E+00

DATE OF RELEASE : 6/27/83
ARC 800 M
AMOUNT OF SF6 RELEASED : 1087 GM

AZIMUTH	CONC (PPT)	TIME (SEC)	EXPOSURE (SEC/M**3)
68	2	6360	0.765E-07
72	0	6360	0.000E+00
76	6	6360	0.230E-06
80	97	6300	0.368E-05
84	168	6360	0.643E-05
88	700	6300	0.265E-04
92	952	6240	0.357E-04
96	888	6300	0.337E-04
100	564	6240	0.212E-04
104	266	6280	0.101E-04
108	185	6240	0.695E-05
112	328	6180	0.122E-04
116	616	6120	0.227E-04
120	1005	6180	0.374E-04
124	677	6120	0.249E-04
128	65	6060	0.237E-05
132	0	6180	0.000E+00

DATE OF RELEASE : 6/27/83
 ARC 1600 M
 AMOUNT OF SF6 RELEASED : 1087 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
70	26	7980	0.125E-05
72	3	7920	0.143E-06
74	0	7920	0.000E+00
76	26	7920	0.124E-05
78	26	7860	0.123E-05
80	0	7860	0.000E+00
82	0	7860	0.000E+00
84	0	7800	0.000E+00
86	0 *	7740	0.000E+00
88	97	7680	0.448E-05
90	171 +	7620	0.784E-05
92	221	7560	0.101E-04
94	177	7560	0.805E-05
96	149	7560	0.678E-05
98	171	7500	0.772E-05
100	179	7500	0.808E-05
102	165	7440	0.739E-05
104	129 +	7440	0.577E-05
106	84	7440	0.376E-05
108	59	7440	0.264E-05
110	49	7440	0.219E-05
112	52	7380	0.231E-05
114	0 +	7320	0.000E+00
116	56	7320	0.247E-05
118	56	7260	0.245E-05
120	0 *	7260	0.000E+00
122	171	7260	0.747E-05
124	139	7260	0.607E-05
126	0 *	7260	0.000E+00
128	10	7200	0.433E-06
130	0	7140	0.000E+00
132	2	7140	0.859E-07
134	0	7140	0.000E+00
136	2	7140	0.859E-07
138	0	7080	0.000E+00

* missing sample
 + flat bag

DATE OF RELEASE : 6/27/83
 ARC 3200 M
 AMOUNT OF SF6 RELEASED : 1087 GM

AZIMUTH	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
74	0	8040	0.000E+00
77	6	7980	0.288E-06
80	0	7740	0.000E+00
83	0	7740	0.000E+00
86	0	7740	0.000E+00
89	8	7740	0.373E-06
92	24	7680	0.111E-05
95	60	7680	0.277E-05
98	40	7680	0.185E-05
101	0 *	7680	0.000E+00
104	33	7620	0.151E-05
107	40	7620	0.183E-05
110	0 +	7620	0.000E+00
113	32	7560	0.146E-05
116	22	7440	0.985E-06
119	26	7440	0.116E-05
122	19	7440	0.851E-06
125	18	7440	0.806E-06
128	1	7380	0.444E-07
131	1	7380	0.444E-07
134	1	7380	0.444E-07
137	0	7380	0.000E+00
140	1	7440	0.448E-07
143	0	0	0.000E+00

* missing sample
 + flat bag

DATE OF RELEASE : 5/26/83
ARC 1600 M TOWER 106
AMOUNT OF ZnS RELEASED : 842 GM
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

HEIGHT	COUNTS	NORM. EXP(SEC/M**3)
0.2	192	0.201E-06
0.4	177	0.186E-06
0.8	222	0.233E-06
1.6	210	0.220E-06
3.1	166	0.174E-06
6.2	158	0.166E-06
9.3	156	0.164E-06
12.4	151	0.158E-06
15.5	154	0.162E-06
18.6	57	0.598E-07
21.7	34	0.357E-07
24.8	7	0.735E-08

DATE OF RELEASE : 5/26/83
ARC 1600 M TOWER 122
AMOUNT OF ZnS RELEASED : 842 GM
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

HEIGHT	COUNTS	NORM. EXP(SEC/M**3)
0.2	3954	0.415E-05
0.4	4167	0.437E-05
0.8	*	
1.6	5158	0.541E-05
3.1	6353	0.667E-05
6.2	7015	0.736E-05
9.3	8460	0.888E-05
12.4	9157	0.961E-05
15.5	7206	0.756E-05
18.6	10357	0.109E-04
21.7	10156	0.107E-04
24.8	*	

* missing sample

DATE OF RELEASE : 5/26/83
ARC 1600 M TOWER 106
AMOUNT OF SF6 RELEASED : 1043 GM

HEIGHT	CONC (PPT)	TIME (SEC)	EXPOSURE (SEC/M**3)
0.2	52	7260	0.237E-05
0.4	52	7260	0.237E-05
0.8	*		
3.1	48	7380	0.222E-05
6.2	40	7500	0.188E-05
12.4	*		
24.8	4	7860	0.197E-05

* missing sample

DATE OF RELEASE : 5/26/83
ARC 1600 M TOWER 122
AMOUNT OF SF6 RELEASED : 1043 GM

HEIGHT	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
0.2	267	7020	0.118E-04
0.4	269	7020	0.118E-04
0.8	*		
3.1	257	7140	0.115E-04
6.2	275	7320	0.126E-04
12.4	325	7500	0.153E-04
24.8	334	7740	0.162E-04

* missing sample

DATE OF RELEASE : 6/5/83
ARC 1600 M TOWER 106
AMOUNT OF ZnS RELEASED : 792 GM
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

HEIGHT	COUNTS	NORM. EXP(SEC/M**3)
0.2	833	0.929E-06
0.4	919	0.103E-05
0.8	713	0.795E-06
1.6	792	0.884E-06
3.1	1162	0.130E-05
6.2	1051	0.117E-05
9.3	1064	0.119E-05
12.4	*	
15.5	887	0.990E-06
18.6	501	0.559E-06
21.7	665	0.742E-06
24.8	533	0.595E-06

* mising sample

DATE OF RELEASE : 6/5/83
ARC 1600 M TOWER 106
AMOUNT OF SF6 RELEASED : 1293 GM

HEIGHT	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
0.2	104	5700	0.300E-05
0.4	96	5700	0.277E-05
0.8	96	5700	0.277E-05
3.1	93	5760	0.271E-05
6.2	79	5820	0.233E-05
12.4	66	5880	0.196E-05
24.8	32	6000	0.971E-06

DATE OF RELEASE : 6/12/83
ARC 1600 M TOWER 106
AMOUNT OF ZnS RELEASED : 840 GM
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

HEIGHT	COUNTS	NORM. EXP(SEC/M**3)
0.2	12212	0.128E-04
0.4	13262	0.140E-04
0.8	13960	0.147E-04
1.6	11865	0.125E-04
3.1	16087	0.169E-04
6.2	16468	0.173E-04
9.3	17941	0.189E-04
12.4	12503	0.132E-04
15.5	11194	0.118E-04
18.6	10765	0.113E-04
21.7	6729	0.708E-05
24.8	5443	0.573E-05

DATE OF RELEASE : 6/12/83
ARC 1600 M TOWER 106
AMOUNT OF SF6 RELEASED : 1134 GM

HEIGHT	CONC (PPT)	TIME (SEC)	EXPOSURE (SEC/M**3)
0.2	1095	6600	0.417E-04
0.4	*		
0.8	*		
3.1	915	6720	0.355E-04
6.2	964	6840	0.380E-04
12.4	820	6840	0.323E-04
24.8	239	6860	0.946E-05

* missing sample

DATE OF RELEASE : 6/27/83
ARC 1600 M TOWER 106
AMOUNT OF Zns RELEASED : 822 GM
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

HEIGHT	COUNTS	NORM. EXP(SEC/M**3)
0.2	580 *	0.623E-06
0.4	755 *	0.812E-06
0.8	644 *	0.692E-06
1.6	1060	0.114E-05
3.1	1348	0.145E-05
6.2	1958	0.210E-05
9.3	1838	0.198E-05
12.4	2101	0.226E-05
15.5	2217	0.238E-05
18.6	2074	0.223E-05
21.7	1778	0.191E-05
24.8		

* dirty filter

DATE OF RELEASE : 6/27/83
ARC 1600 M TOWER 122
AMOUNT OF ZnS RELEASED : 822 GM
FLOWRATE FOR FILTERS : 0.232E-03 M**3/SEC

HEIGHT	COUNTS	NORM. EXP(SEC/M**3)
0.2	2410	0.259E-05
0.4	3432	0.369E-05
0.8	1704	0.183E-05
1.6	2396	0.258E-05
3.1	3729	0.401E-05
6.2	4442	0.477E-05
9.3	4037	0.434E-05
12.4	3608	0.388E-05
15.5	2308	0.248E-05
18.6	2336	0.251E-05
21.7	2427	0.261E-05
24.8		

DATE OF RELEASE : 6/27/83
ARC 1600 M TOWER 106
AMOUNT OF SF6 RELEASED : 1087 GM

HEIGHT	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
0.2	93	6720	0.376E-05
0.4	110	6720	0.445E-05
0.8	99	6720	0.400E-05
3.1	103	7620	0.472E-05
6.2	118	7680	0.545E-05
12.4	89	7740	0.414E-05
24.8	72	7800	0.338E-05

DATE OF RELEASE : 6/27/83
ARC 1600 M TOWER 122
AMOUNT OF SF6 RELEASED : 1087 GM

HEIGHT	CONC(PPT)	TIME(SEC)	EXPOSURE(SEC/M**3)
0.2	*		
0.4	176	5400	0.572E-05
0.8	*		
3.1	163	5520	0.541E-05
6.2	163	5580	0.547E-05
12.4	139	5640	0.472E-05
24.8	64	5700	0.219E-05

* missing sample

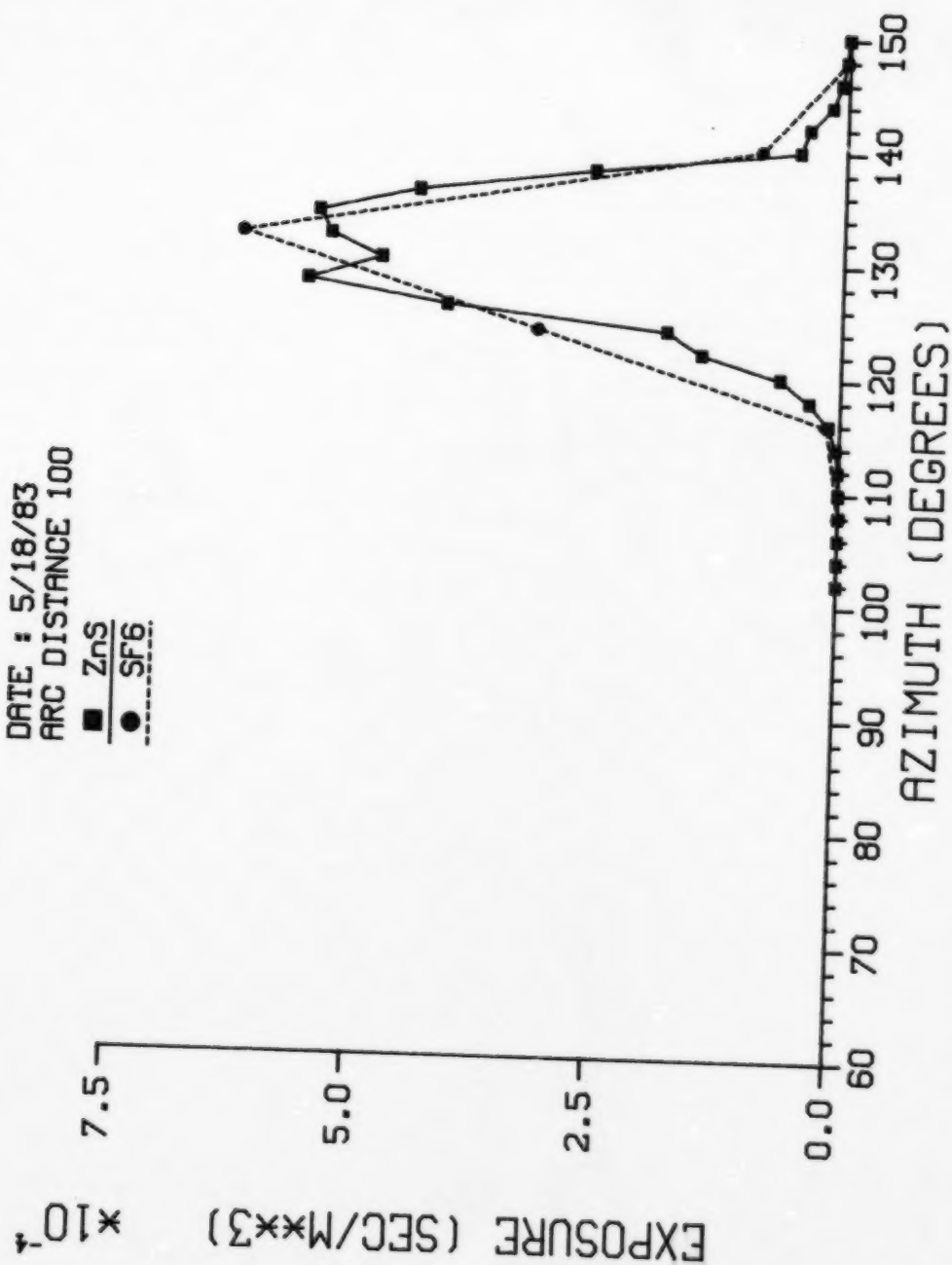


Figure C-1. Tracer concentrations at the 100 m arc for release of May 18, 1983.

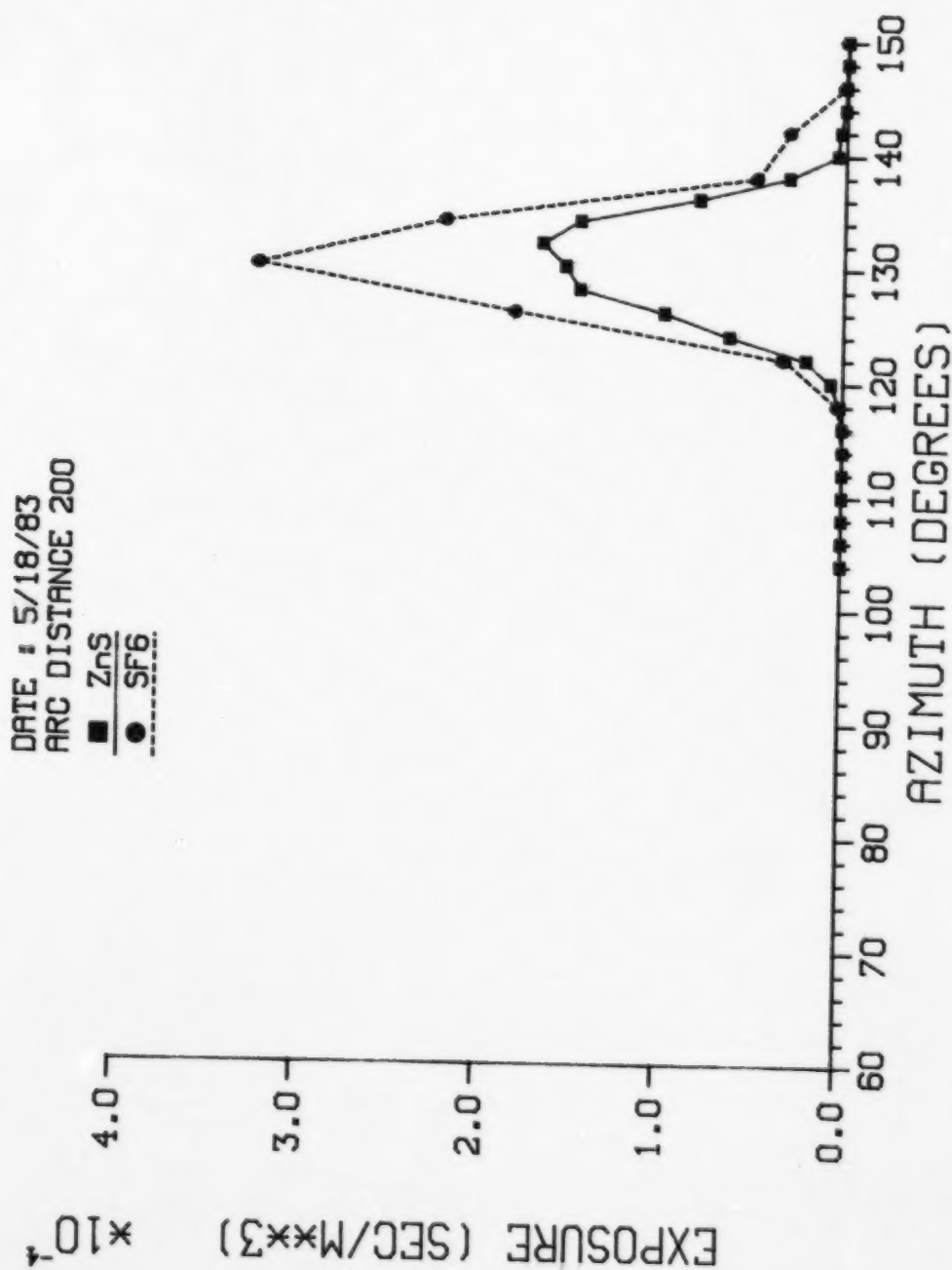


Figure C-2. Tracer concentrations at the 200 m arc for release of May 18, 1983.

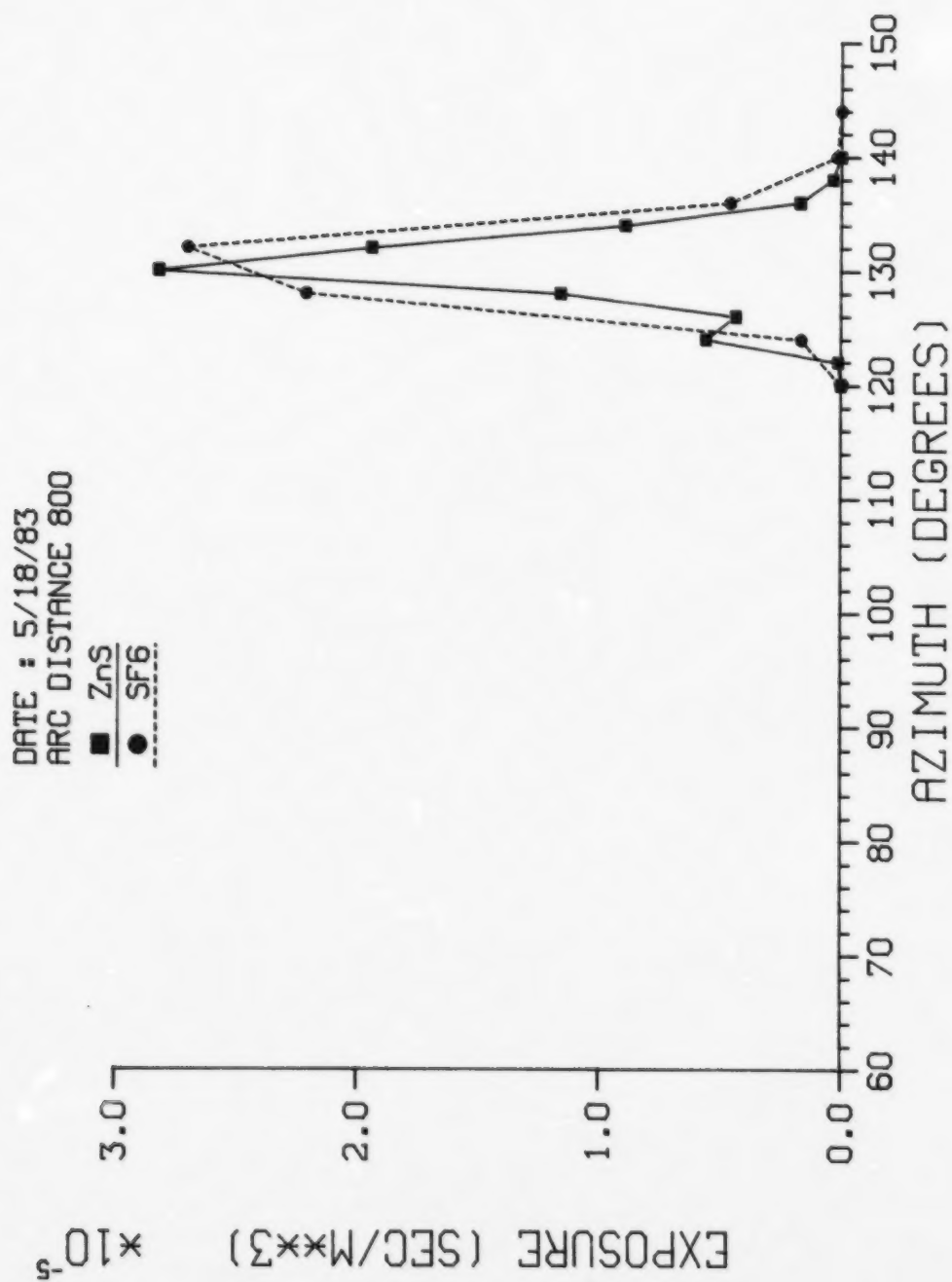


Figure C-3. Tracer concentrations at the 800 m arc for release of May 18, 1983.

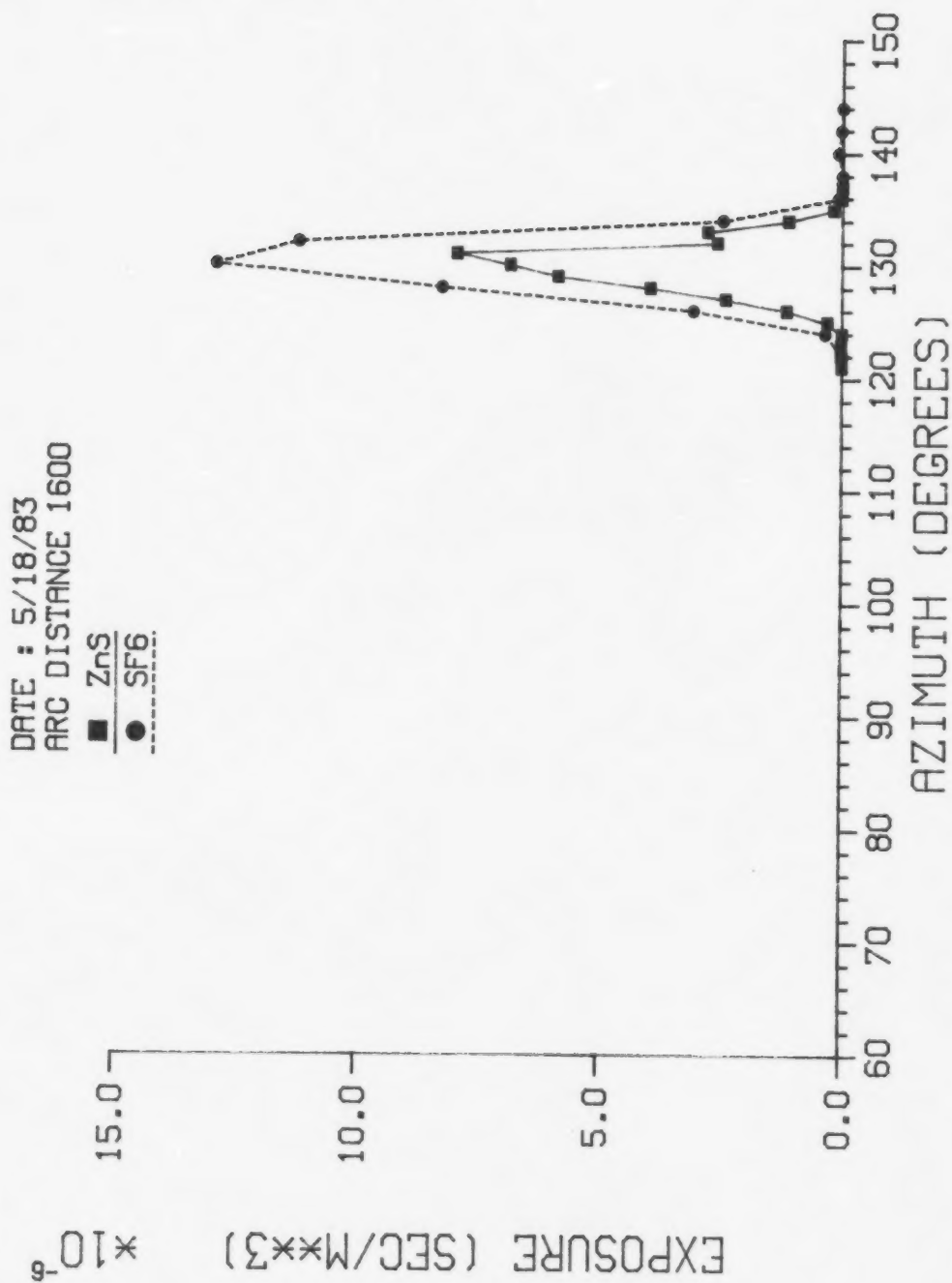


Figure C-4. Tracer concentrations at the 1600 m arc for release of May 18, 1983.

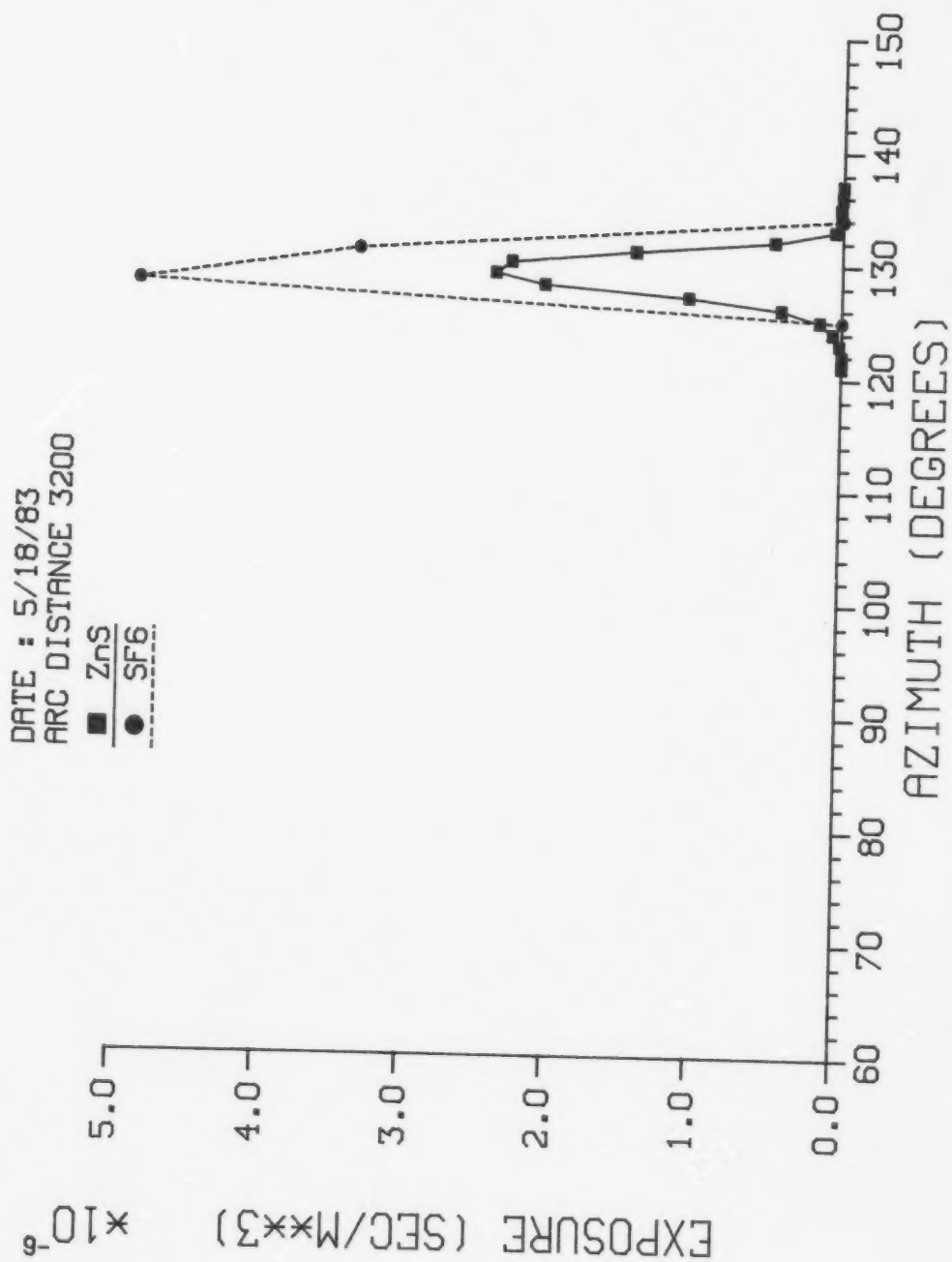


Figure C-5. Tracer concentrations at the 3200 m arc for release of May 18, 1983.

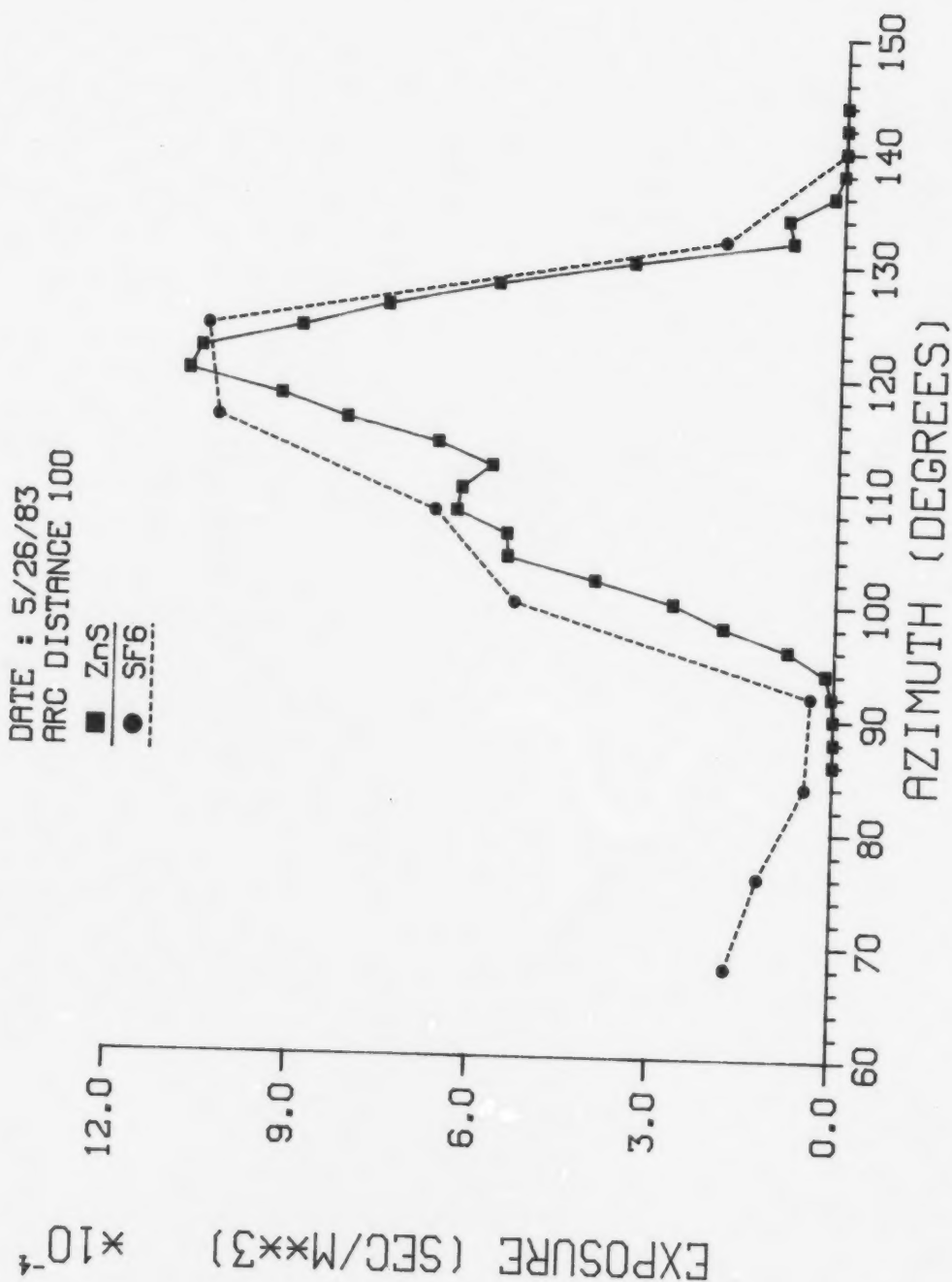


Figure C-6. Tracer concentrations at the 100 m arc for release of May 26, 1983.

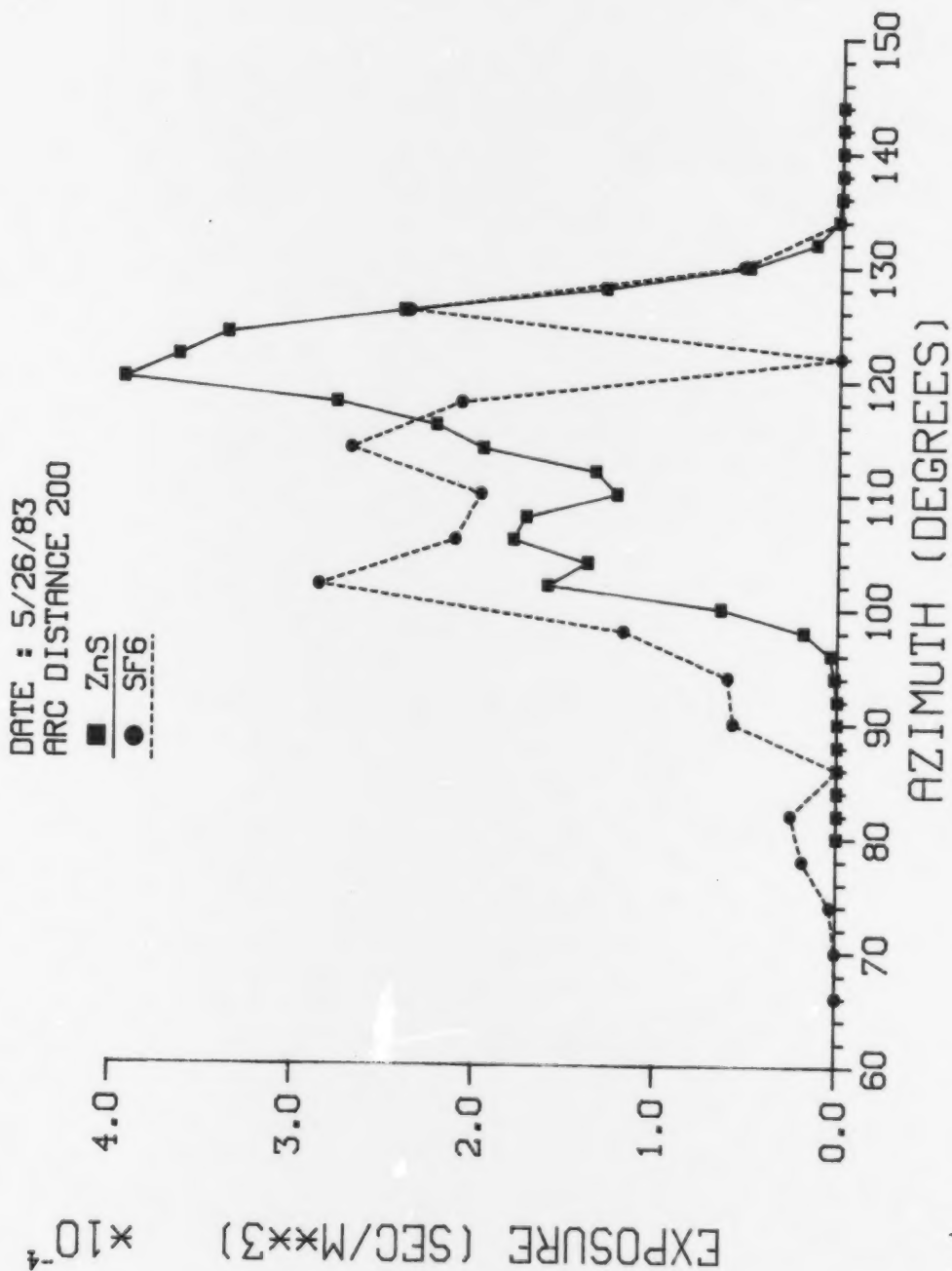


Figure C-7. Tracer concentrations at the 200 m arc for release of May 26, 1983.

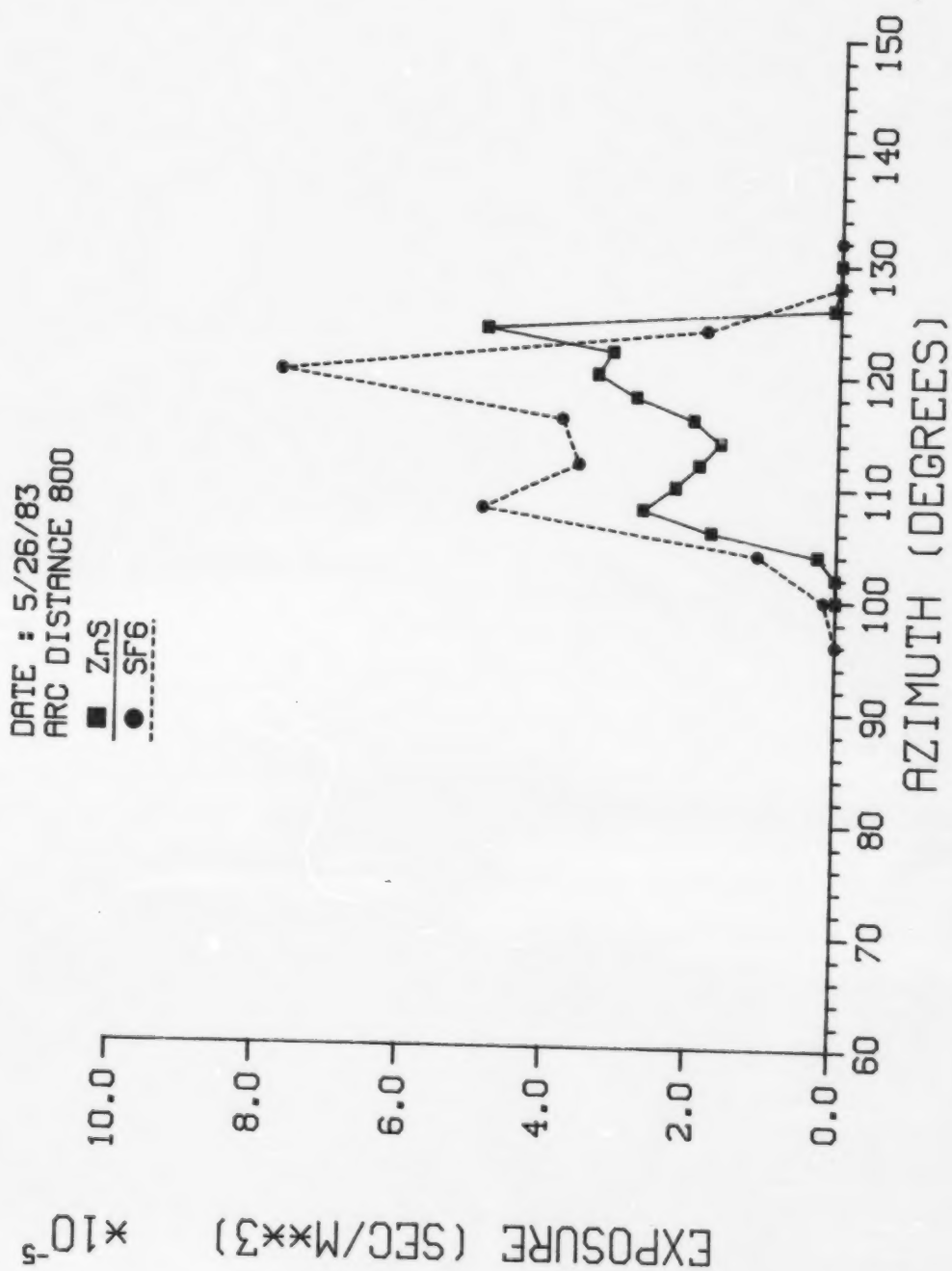


Figure C-8. Tracer concentrations at the 800 m arc for release of May 26, 1983.

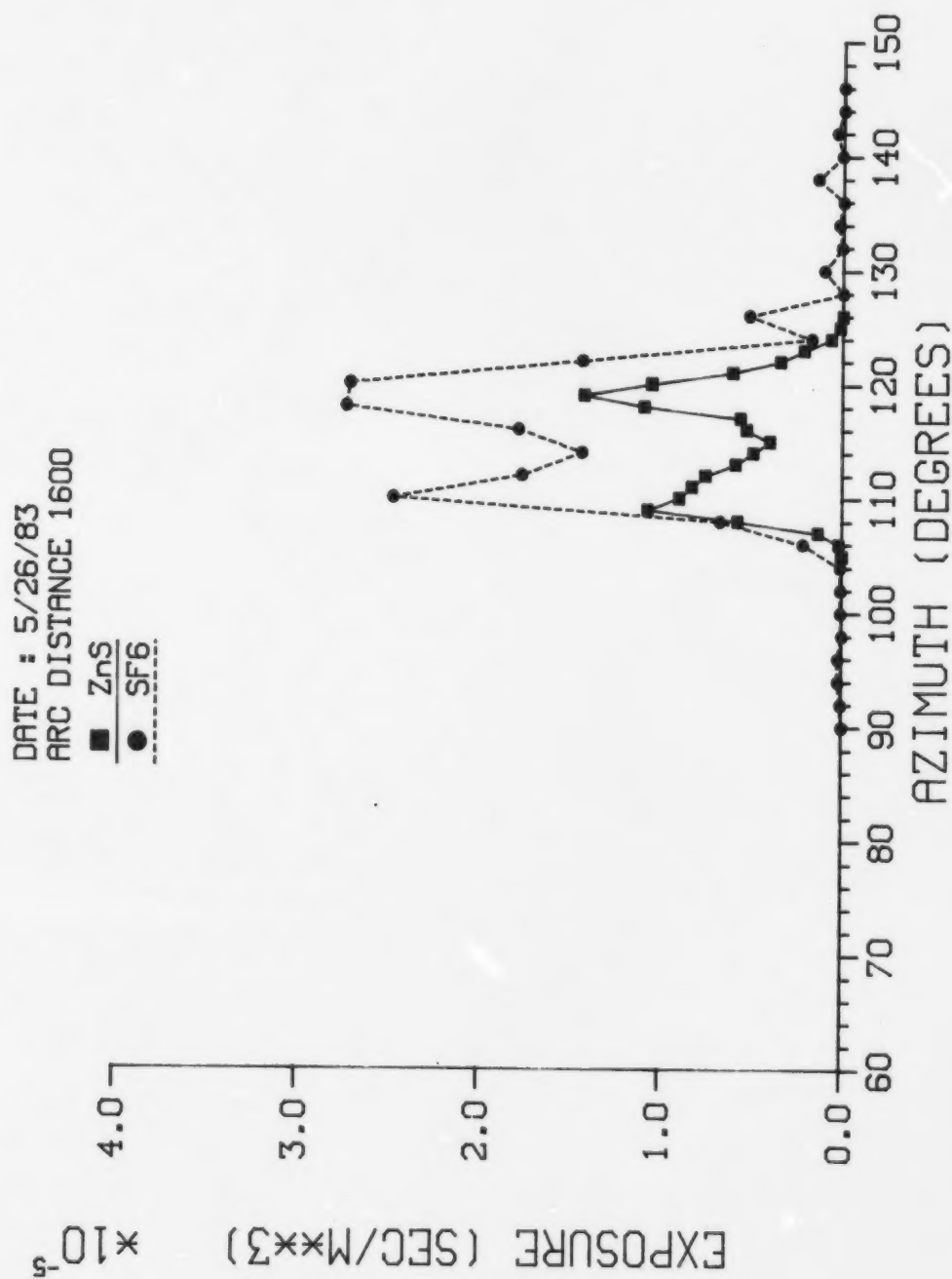


Figure C-9. Tracer concentrations at the 1600 m arc for release of May 26, 1983.

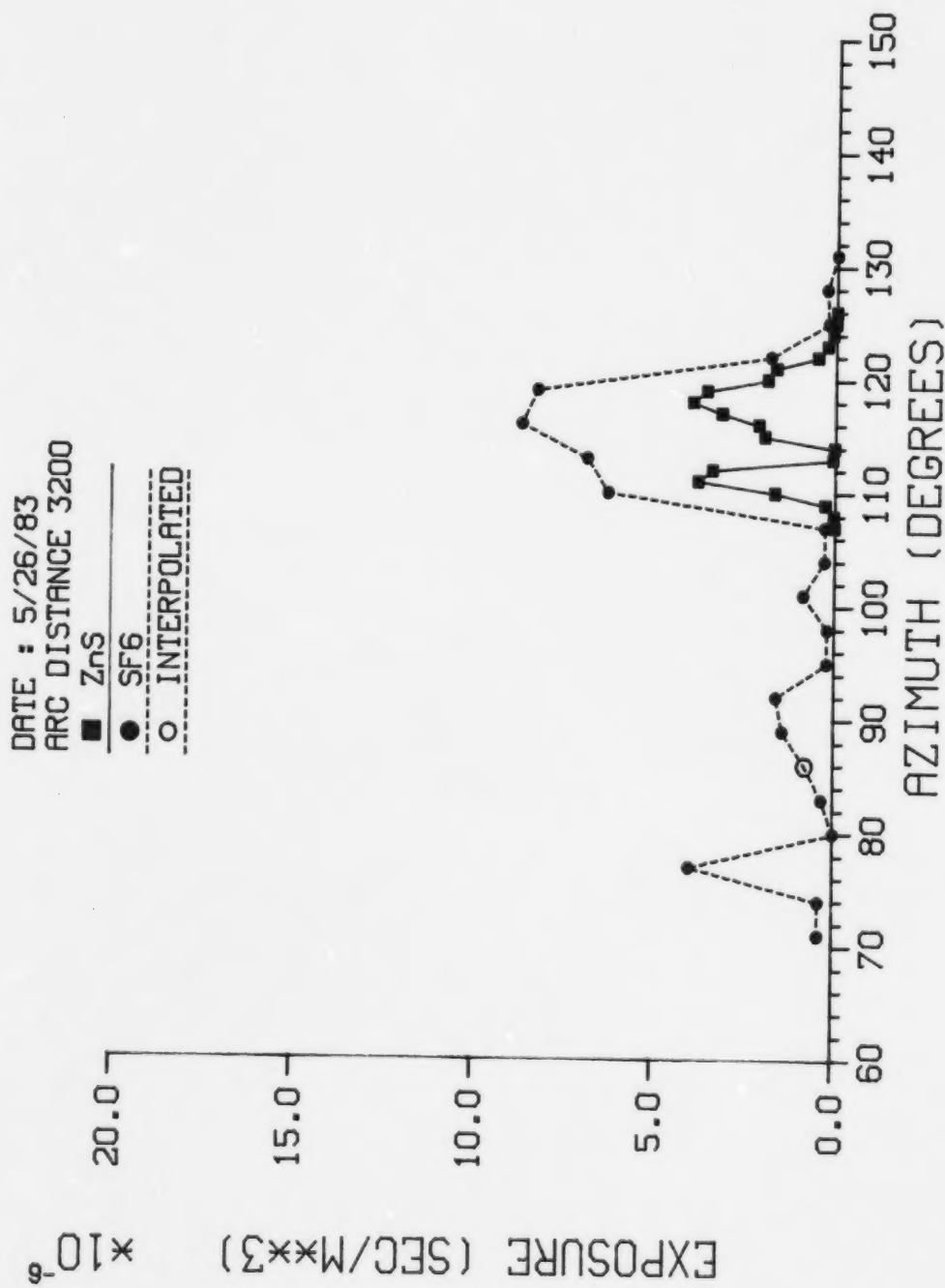


Figure C-10. Tracer concentrations at the 3200 m arc for release of May 26, 1983.

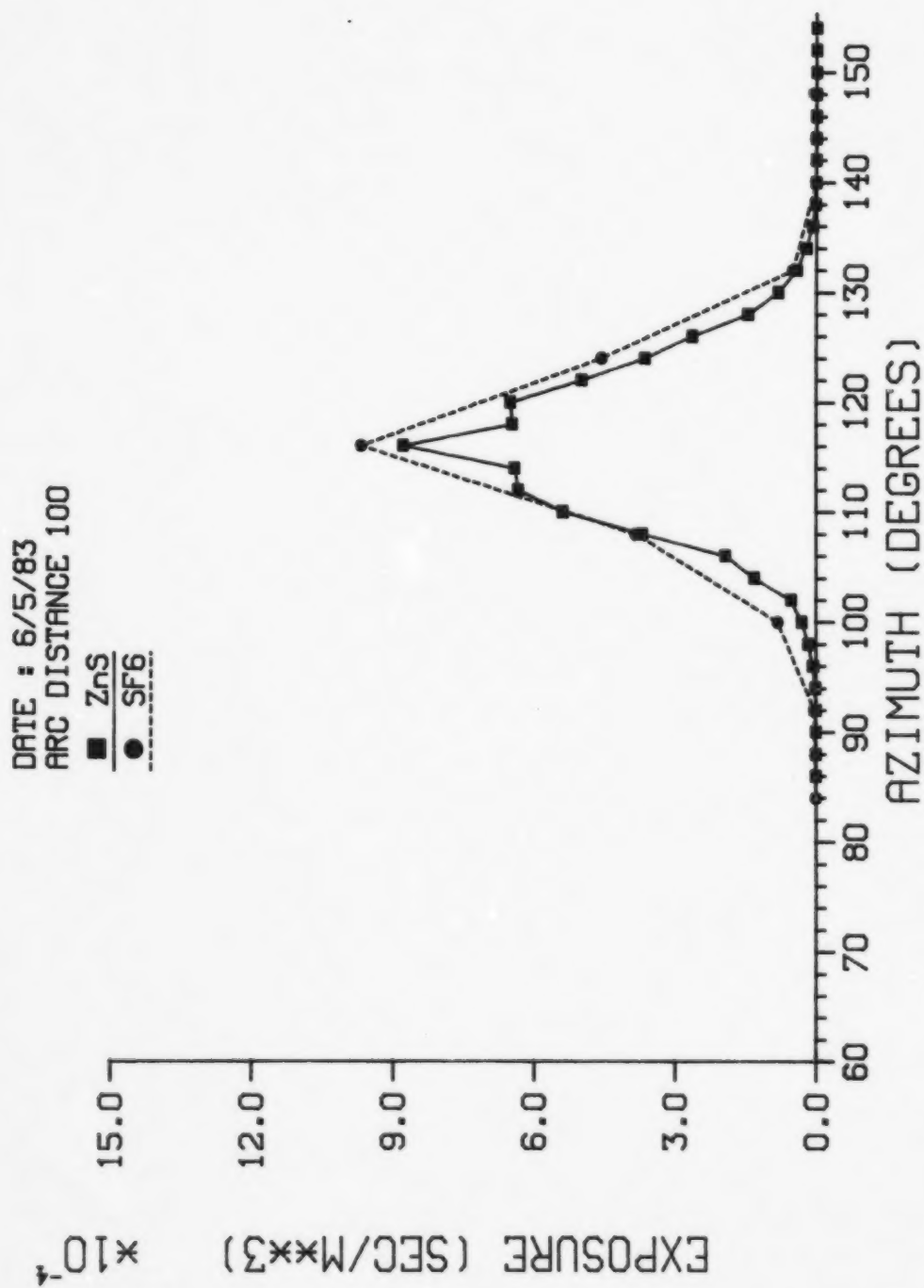


Figure C-11. Tracer concentrations at the 100 m arc for release of June 5, 1983.

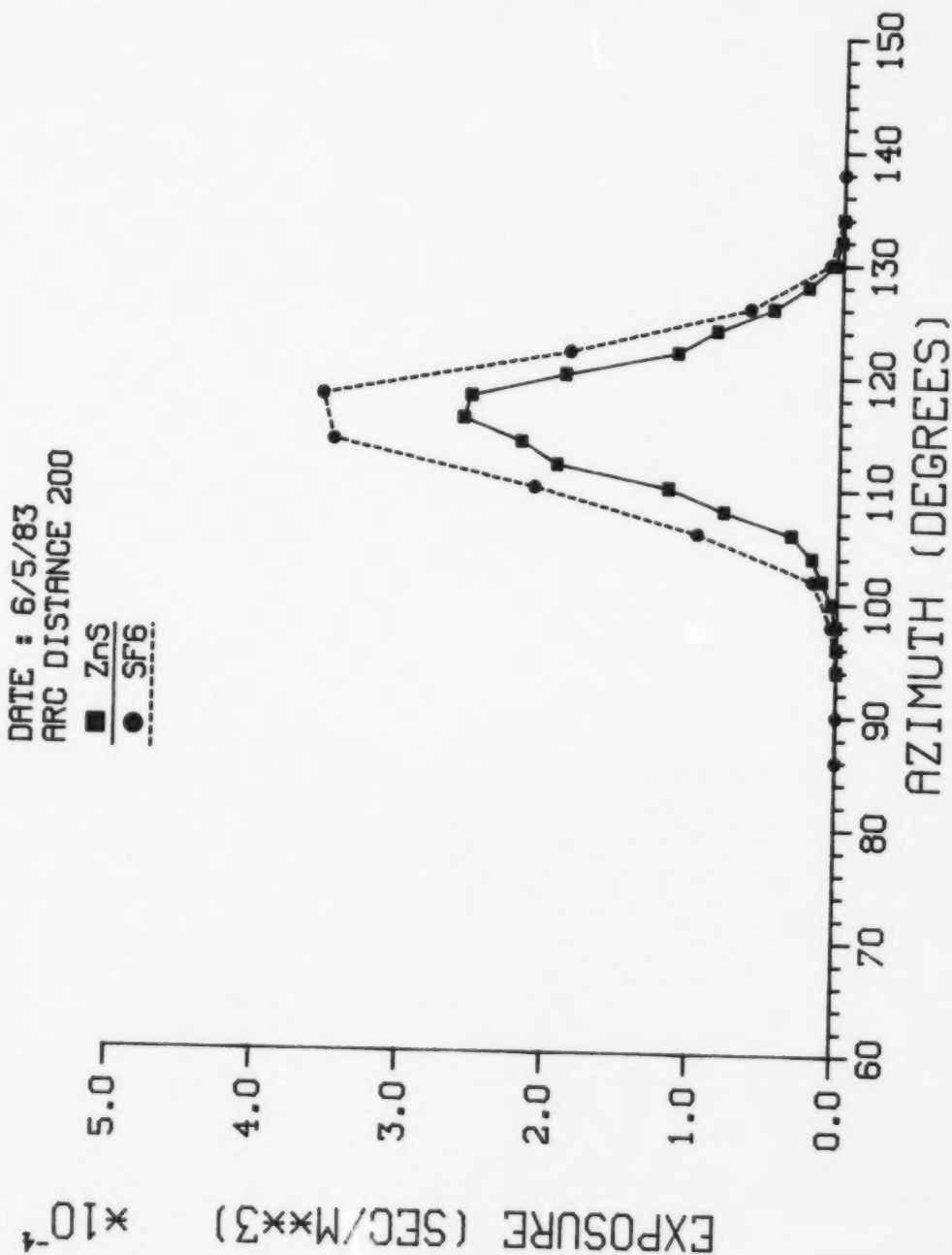


Figure C-12. Tracer concentrations at the 200 m arc for release of June 5, 1983.

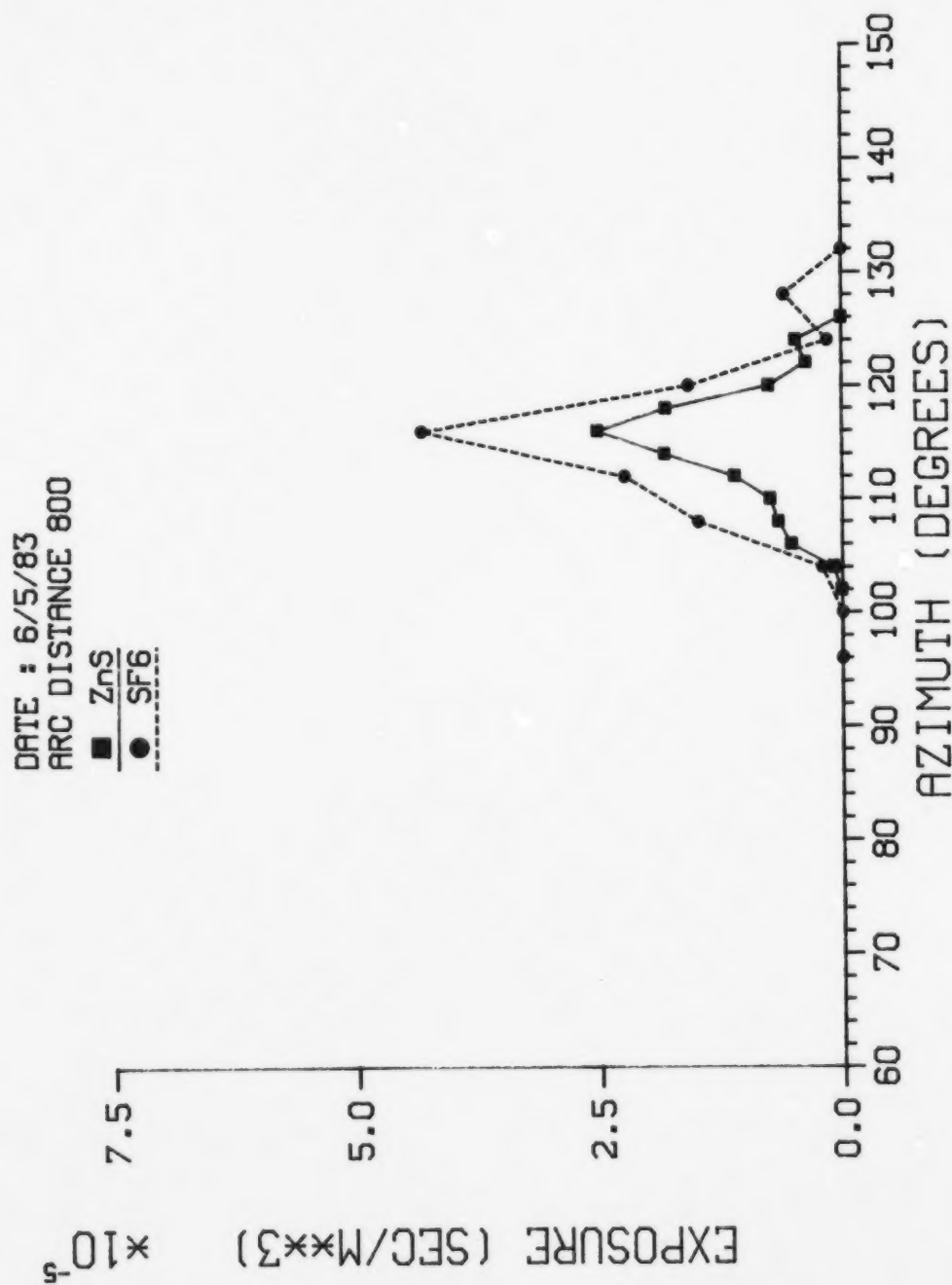


Figure C-13. Tracer concentrations at the 800 m arc for release of June 5, 1983.

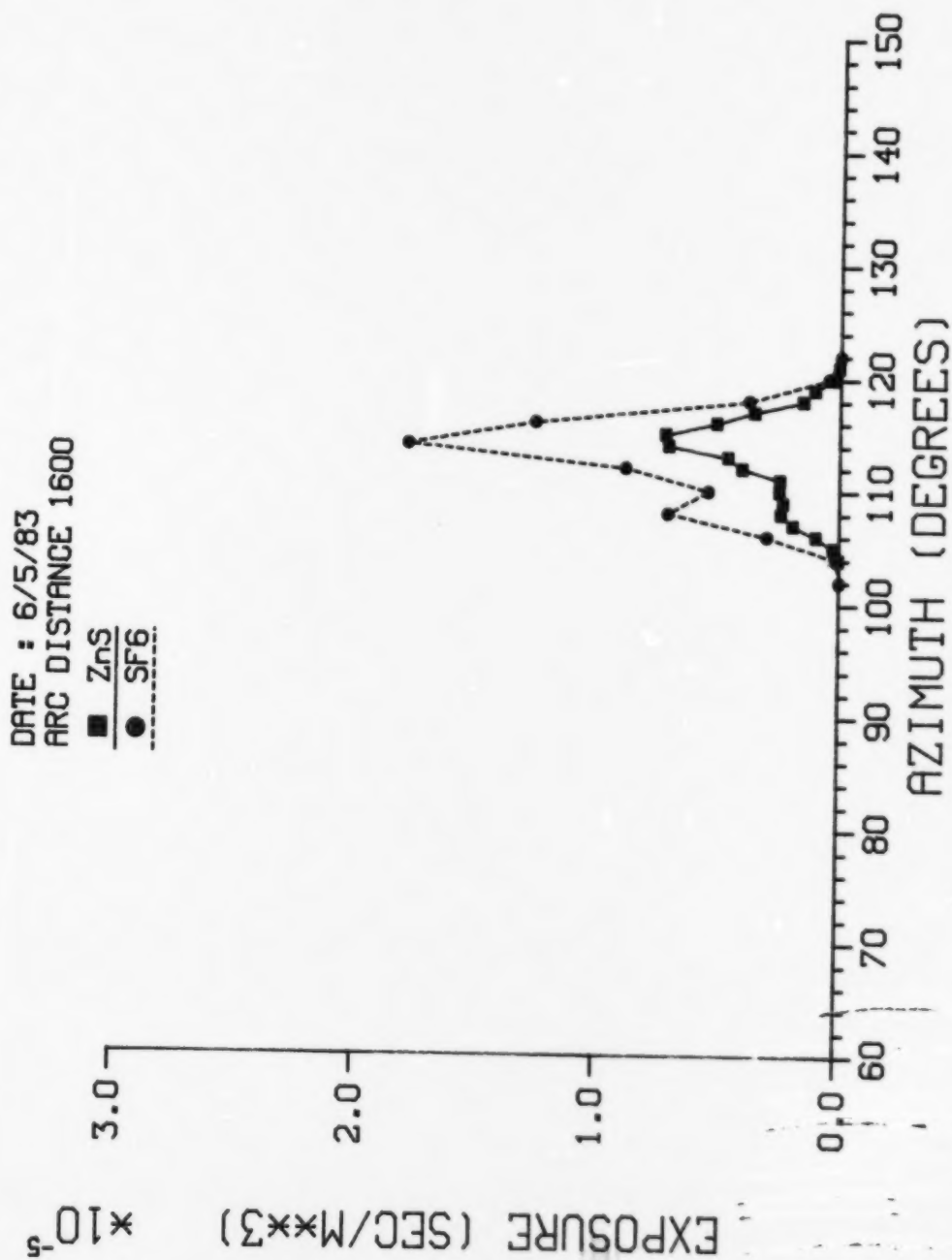


Figure C-14. Tracer concentrations at the 1600 m arc for release of June 5, 1983.

DATE : 6/5/83
ARC DISTANCE 3200

■ ZnS
● SF6

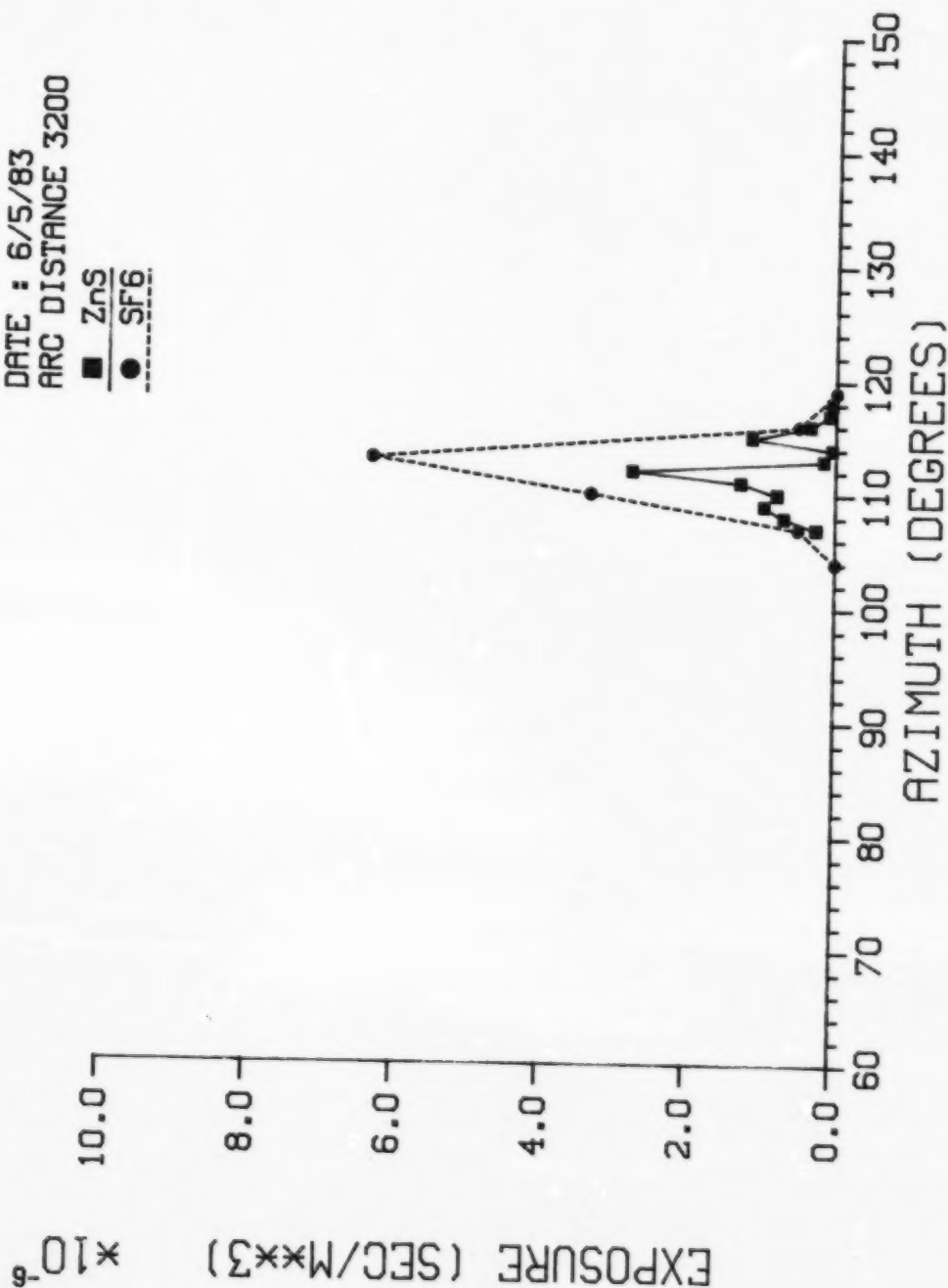


Figure C-15. Tracer concentrations at the 3200 m arc for release of June 5, 1983.

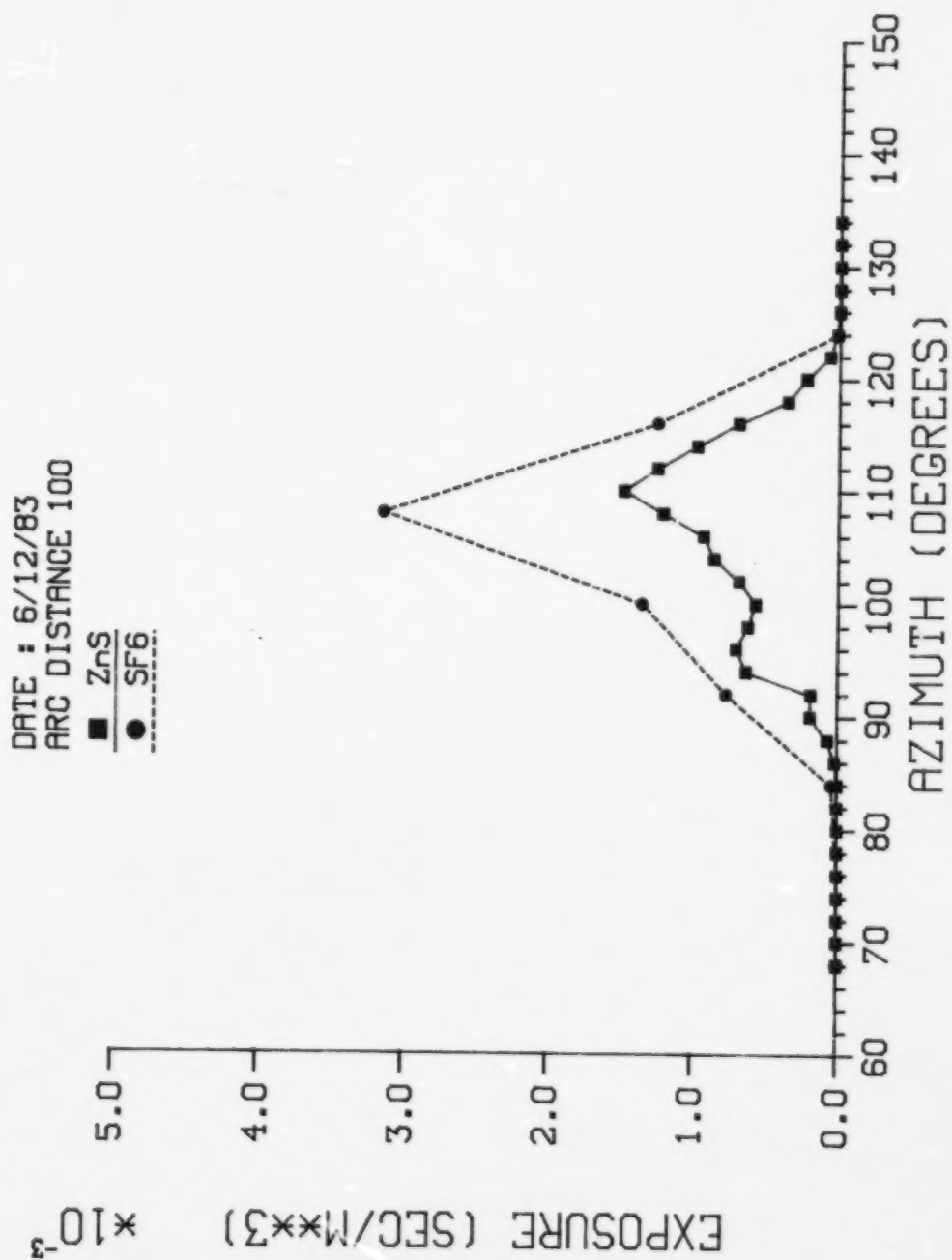


Figure C-16. Tracer concentrations at the 100 m arc for release of June 12, 1983.

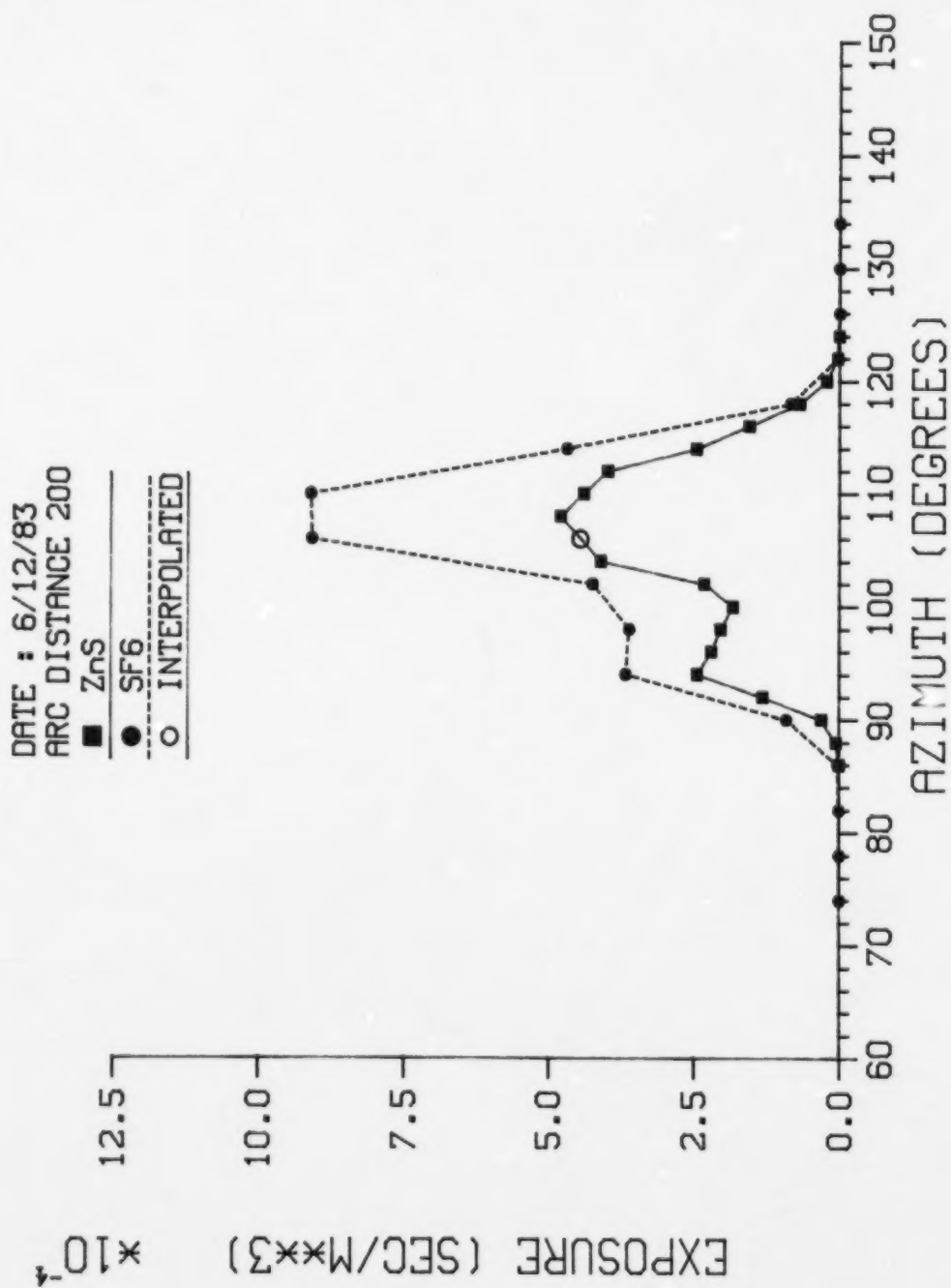


Figure C-17. Tracer concentrations at the 200 m arc for release of June 12, 1983.

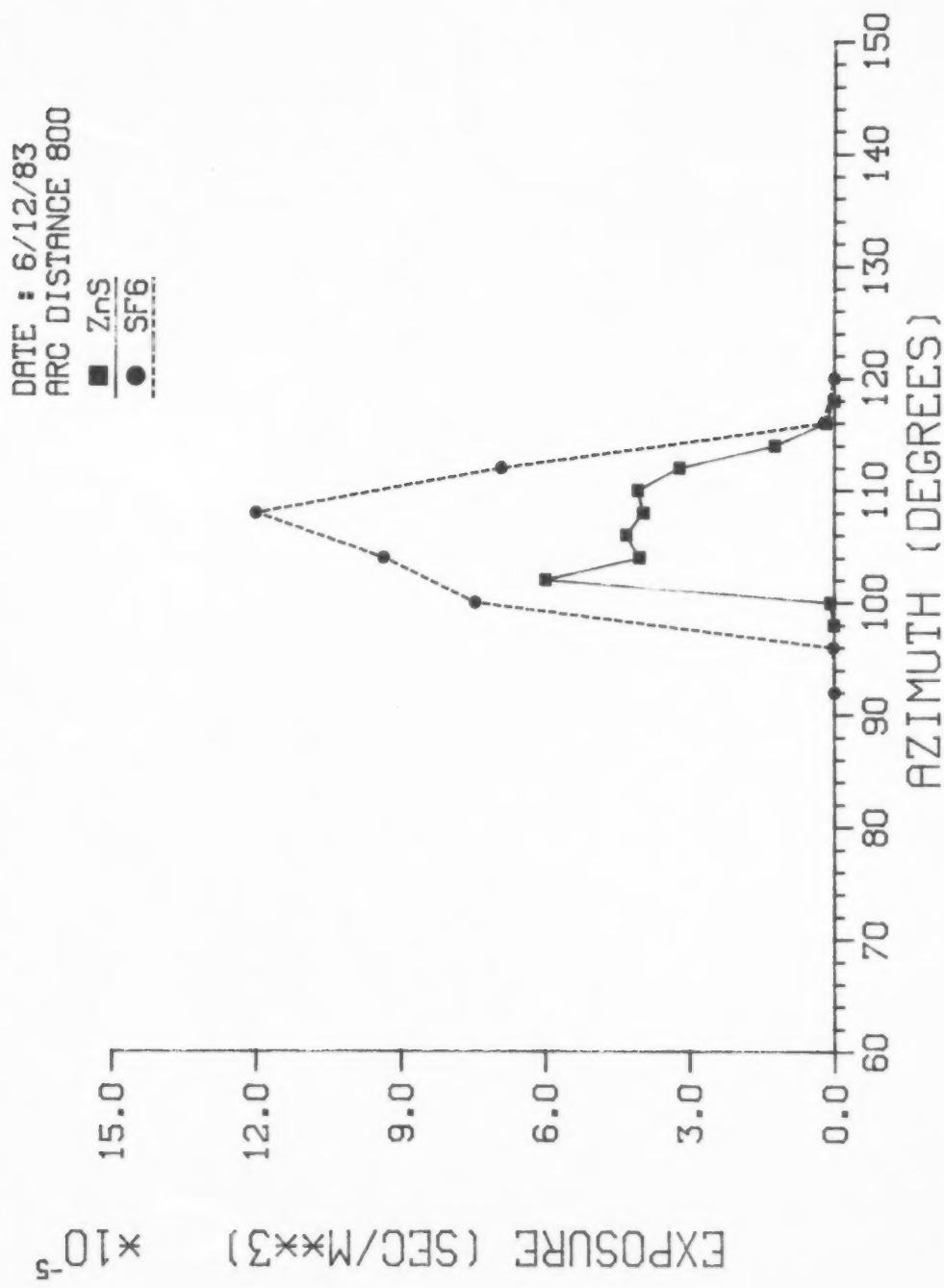


Figure C-18. Tracer concentrations at the 800 m arc for release of June 12, 1983.

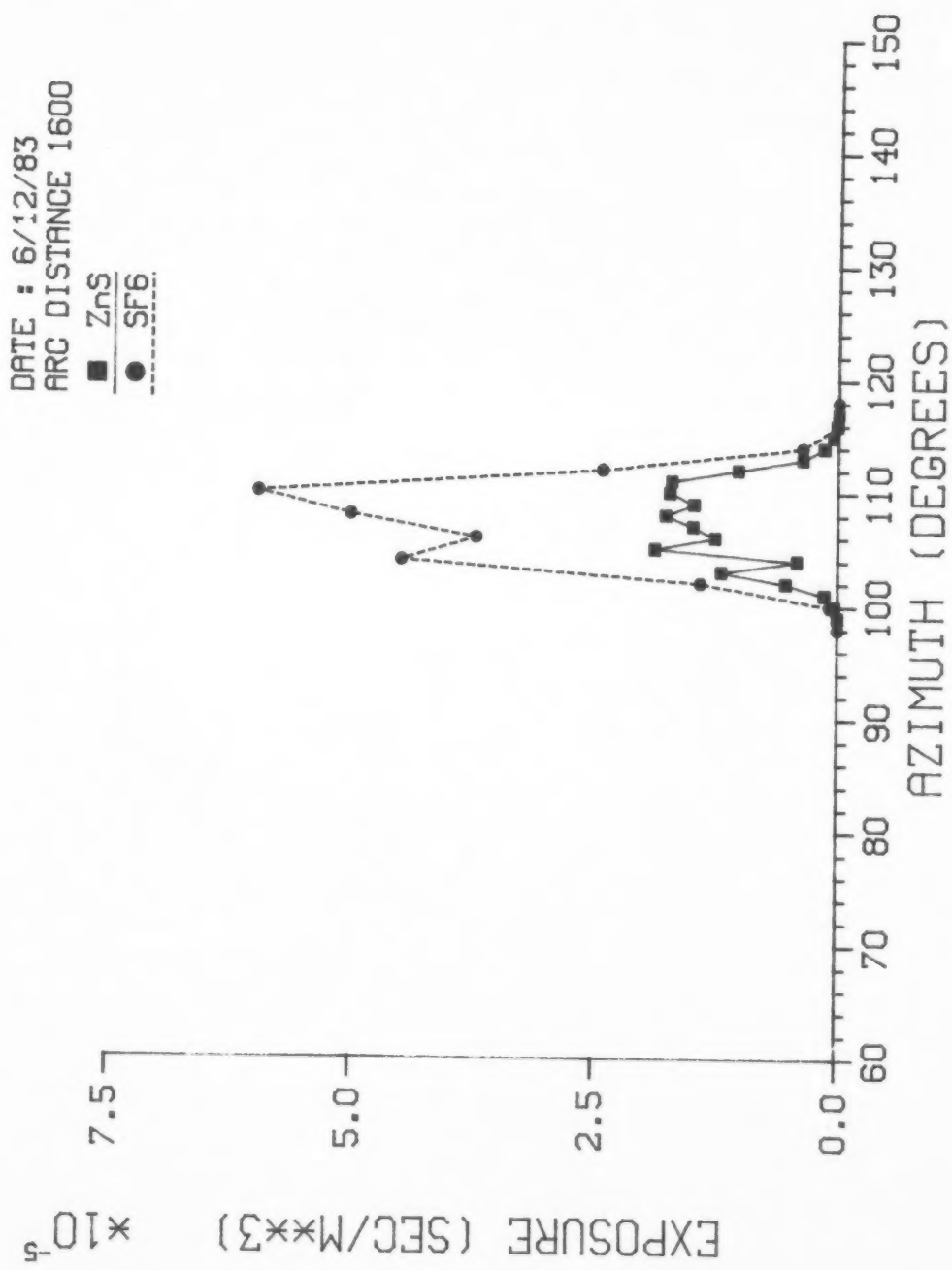


Figure C-19. Tracer concentrations at the 1600 m arc for release of June 12, 1983.

DATE : 6/12/83
 ARC DISTANCE 3200

■ ZnS
 ● SF6

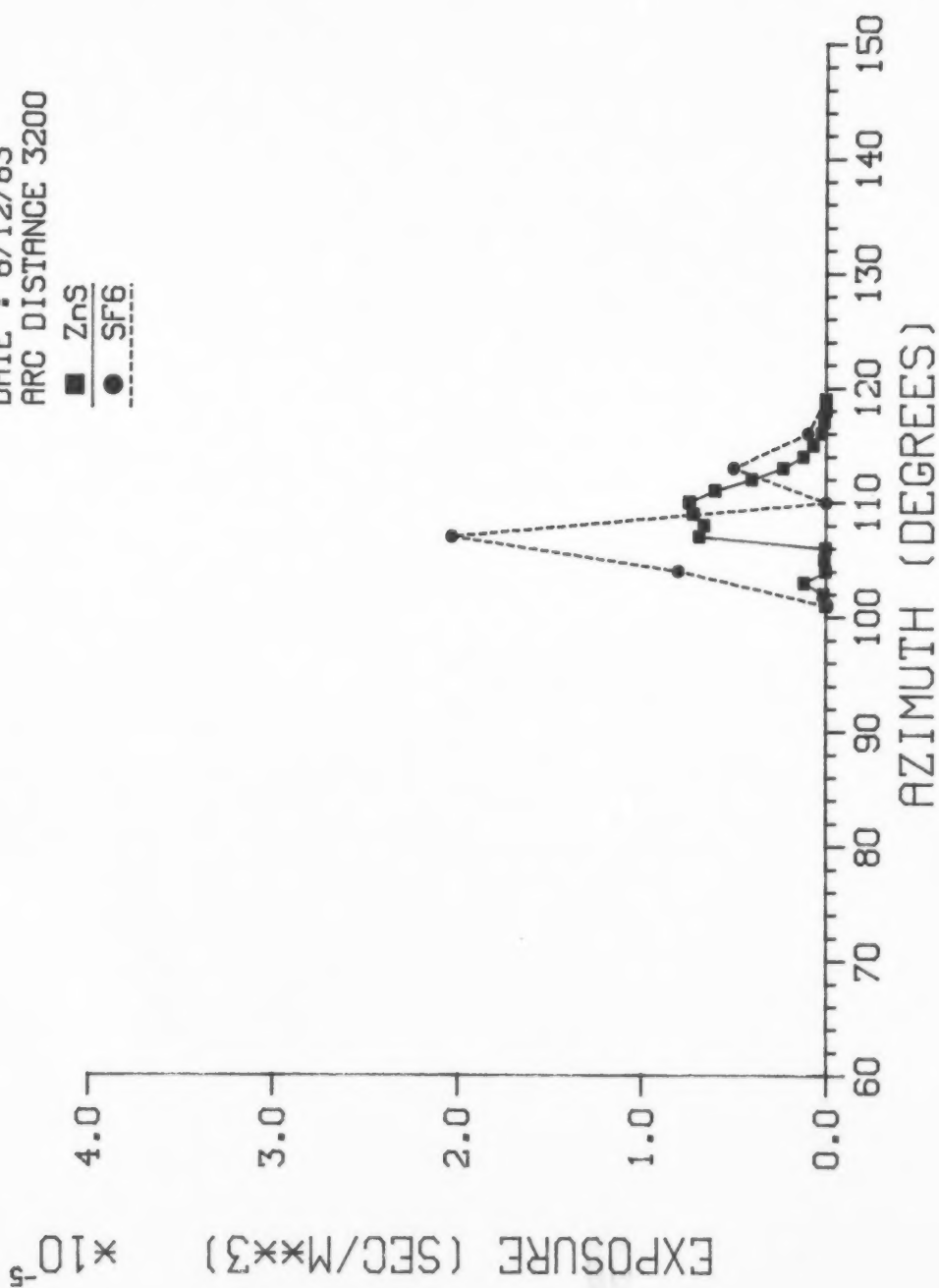


Figure C-20. Tracer concentrations at the 3200 m arc for release of June 12, 1983.

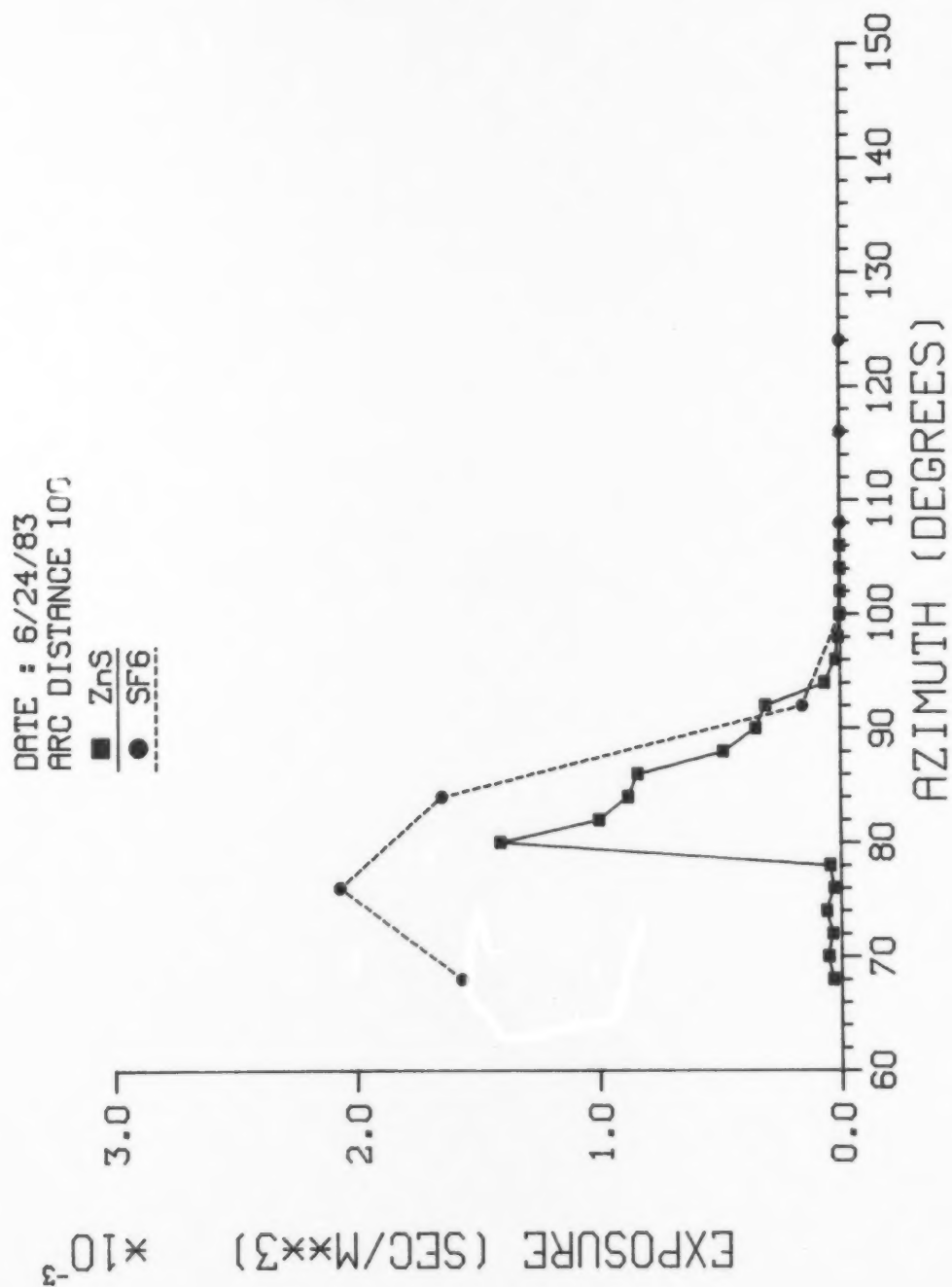


Figure C-21. Tracer concentrations at the 100 m arc for release of June 24, 1983.

DATE : 6/24/83
ARC DISTANCE 200

■ ZnS
● SF6

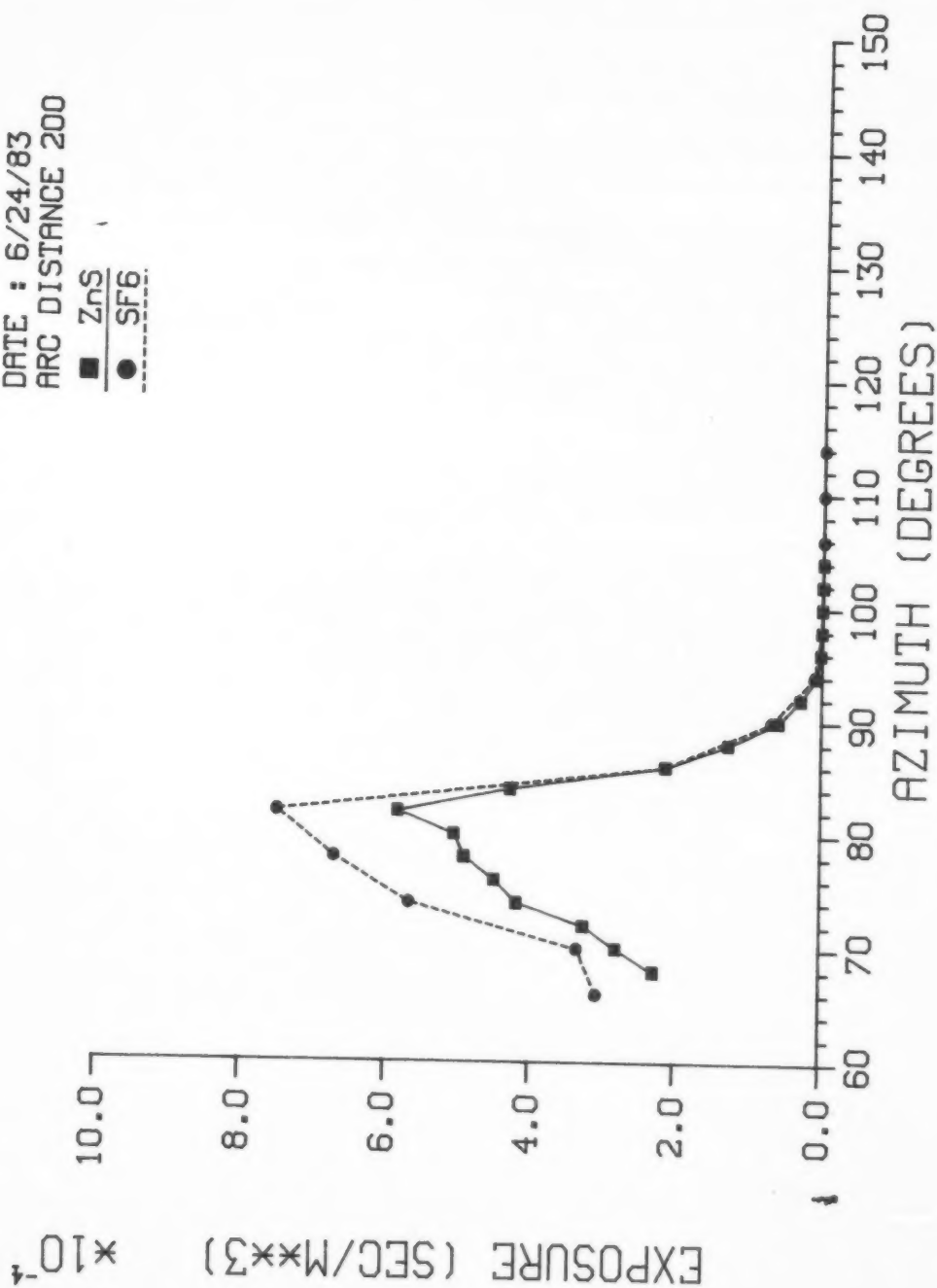


Figure C-22. Tracer concentrations at the 200 m arc for release of June 24, 1983.

DATE : 6/24/83
ARC DISTANCE 800

■ ZnS
● SF6

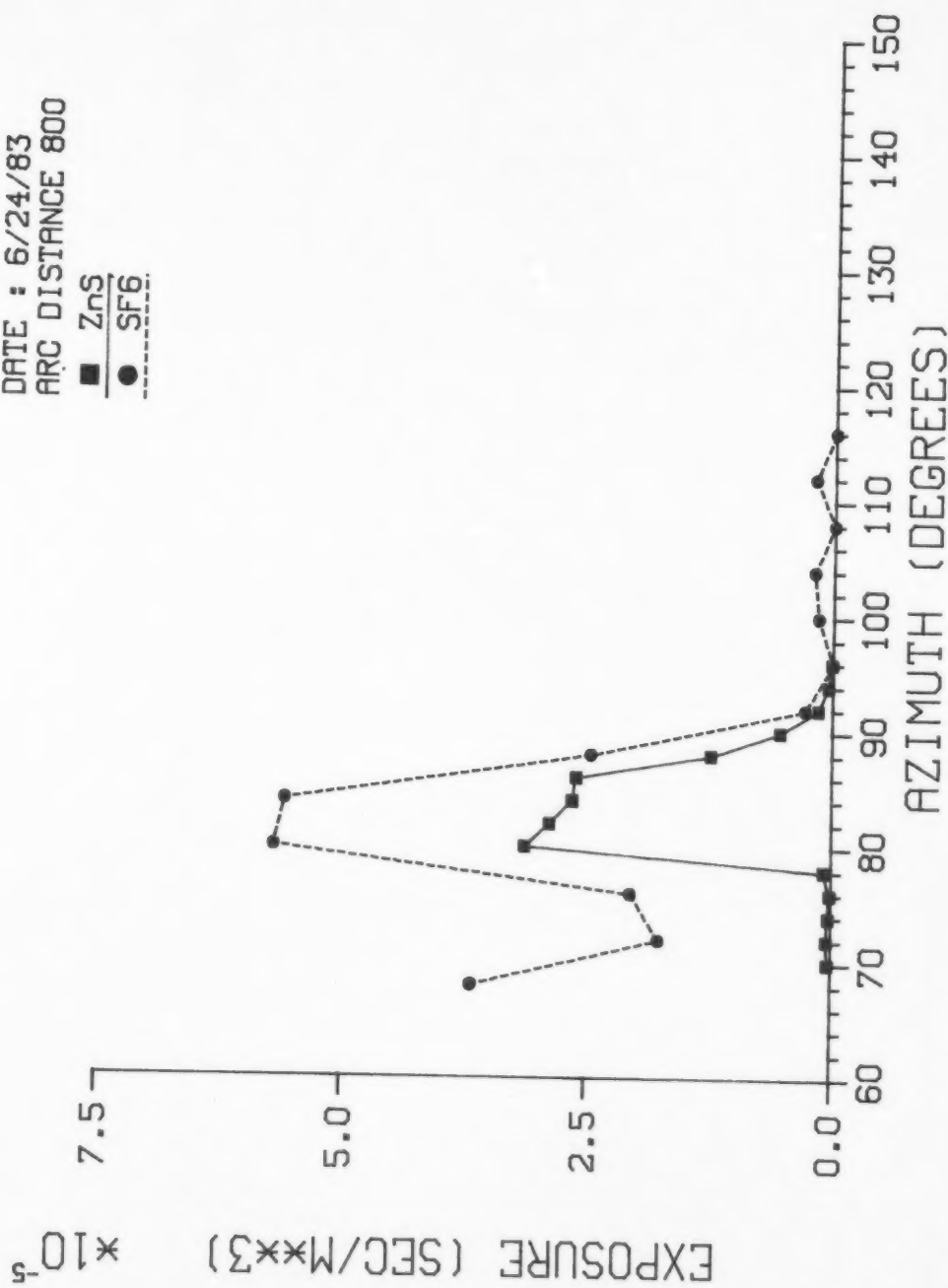


Figure C-23. Tracer concentrations at the 800 m arc for release of June 24, 1983.

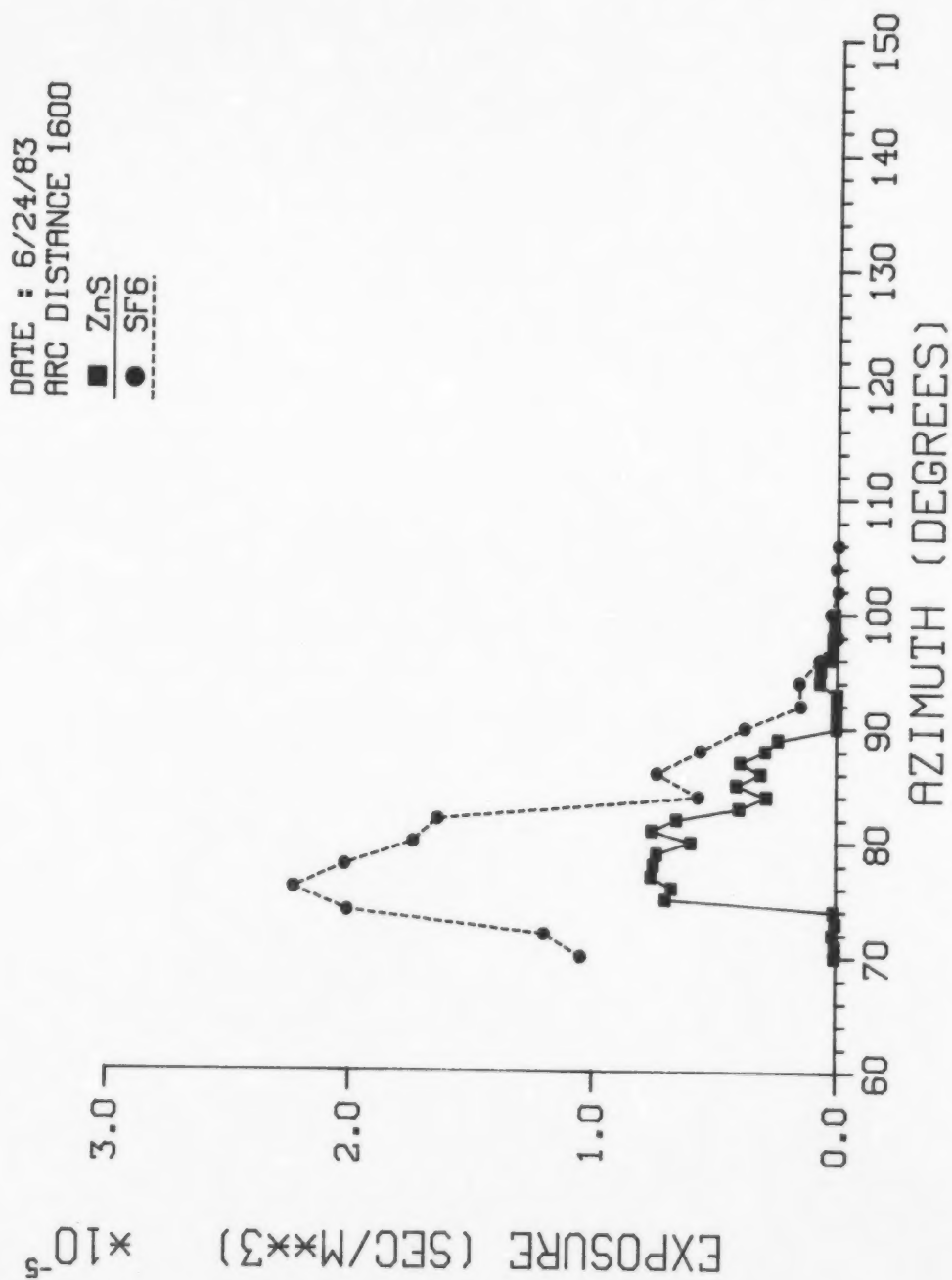


Figure C-24. Tracer concentrations at the 1600 m arc for release of June 24, 1983.

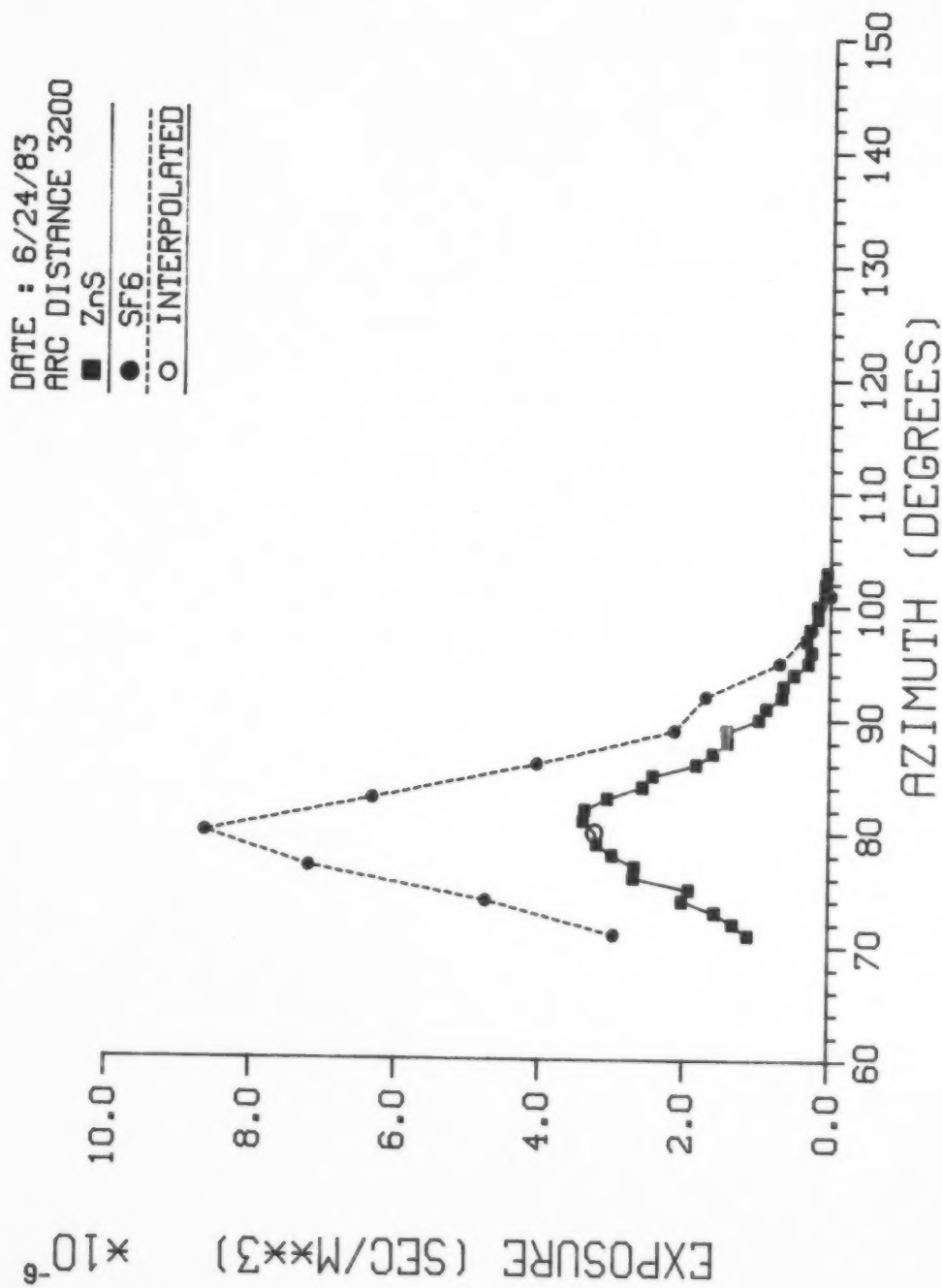


Figure C-25. Tracer concentrations at the 3200 m arc for release of June 24, 1983.

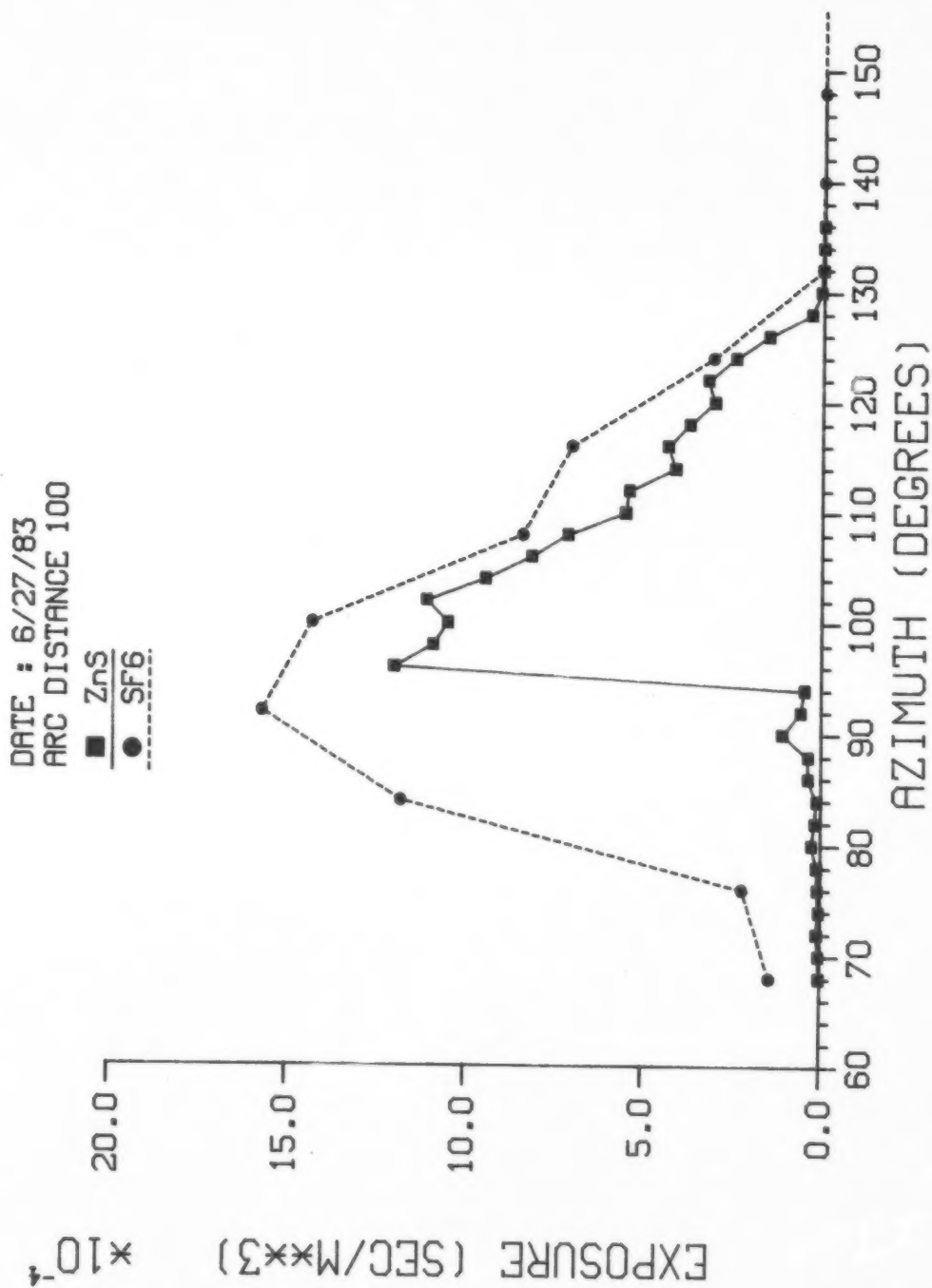


Figure C-26. Tracer concentrations at the 100 m arc for release of June 27, 1983.

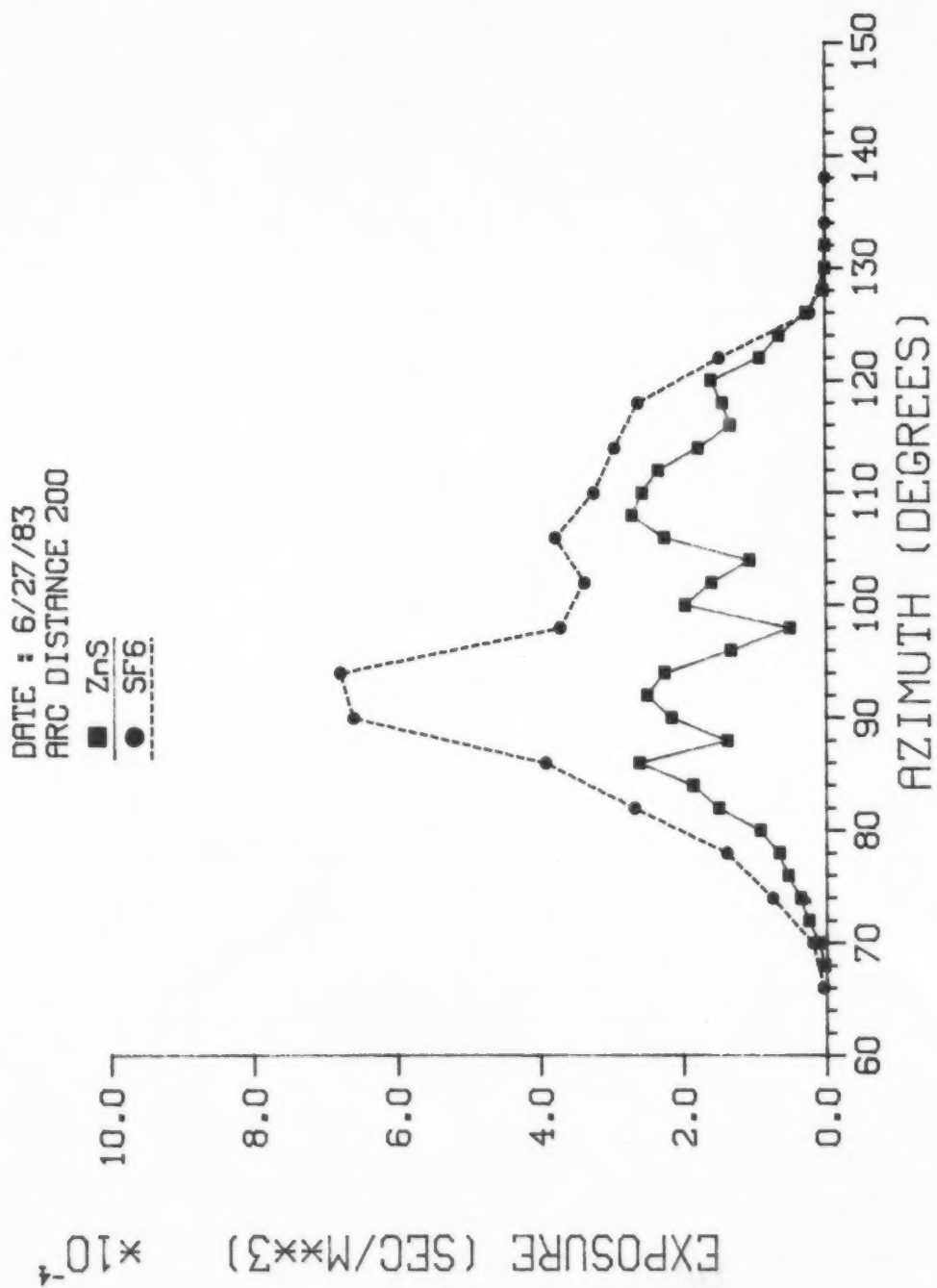


Figure C-27. Tracer concentrations at the 200 m arc for release of June 27, 1983.

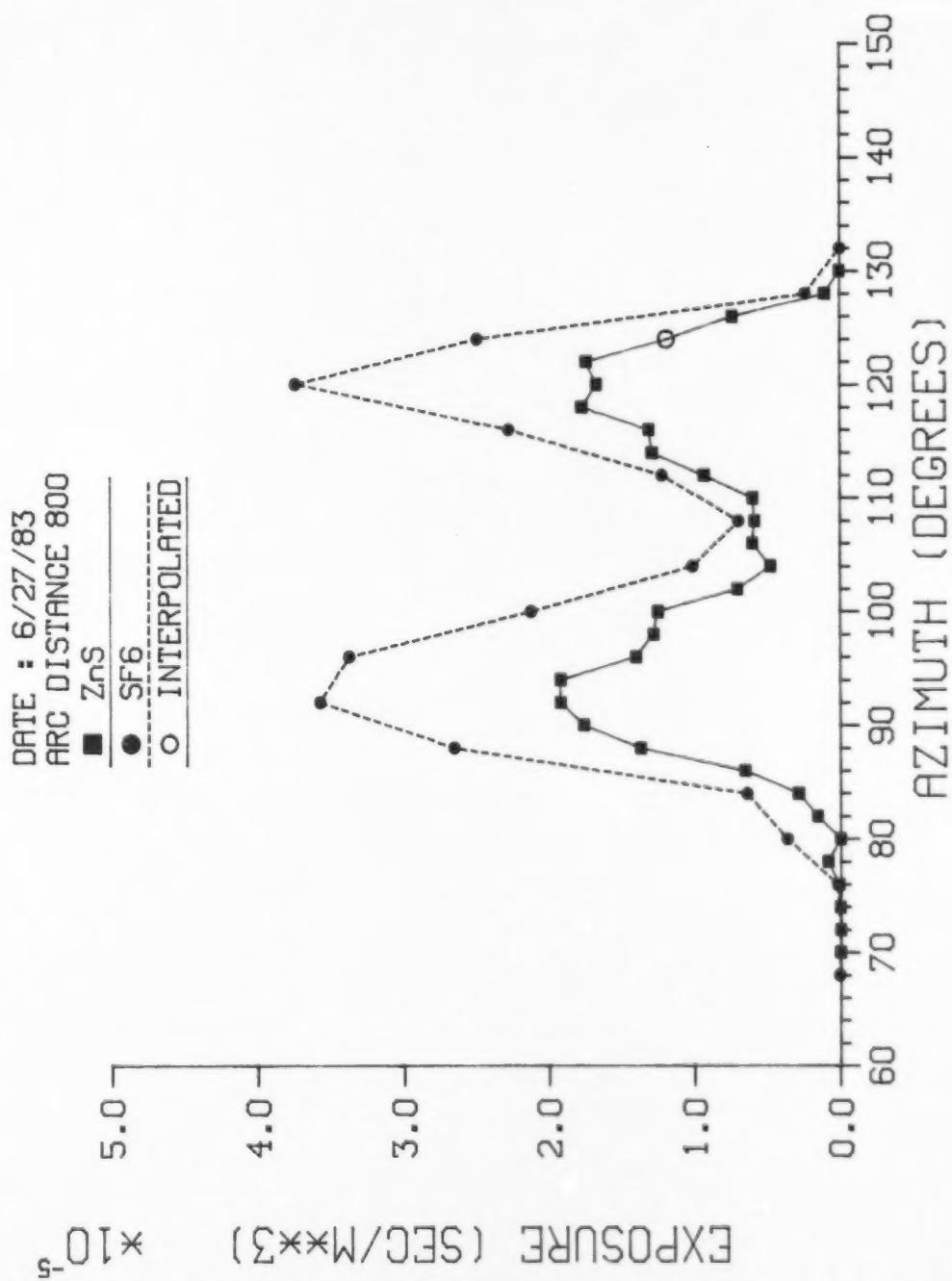


Figure C-28. Tracer concentrations at the 800 m arc for release of June 27, 1983.

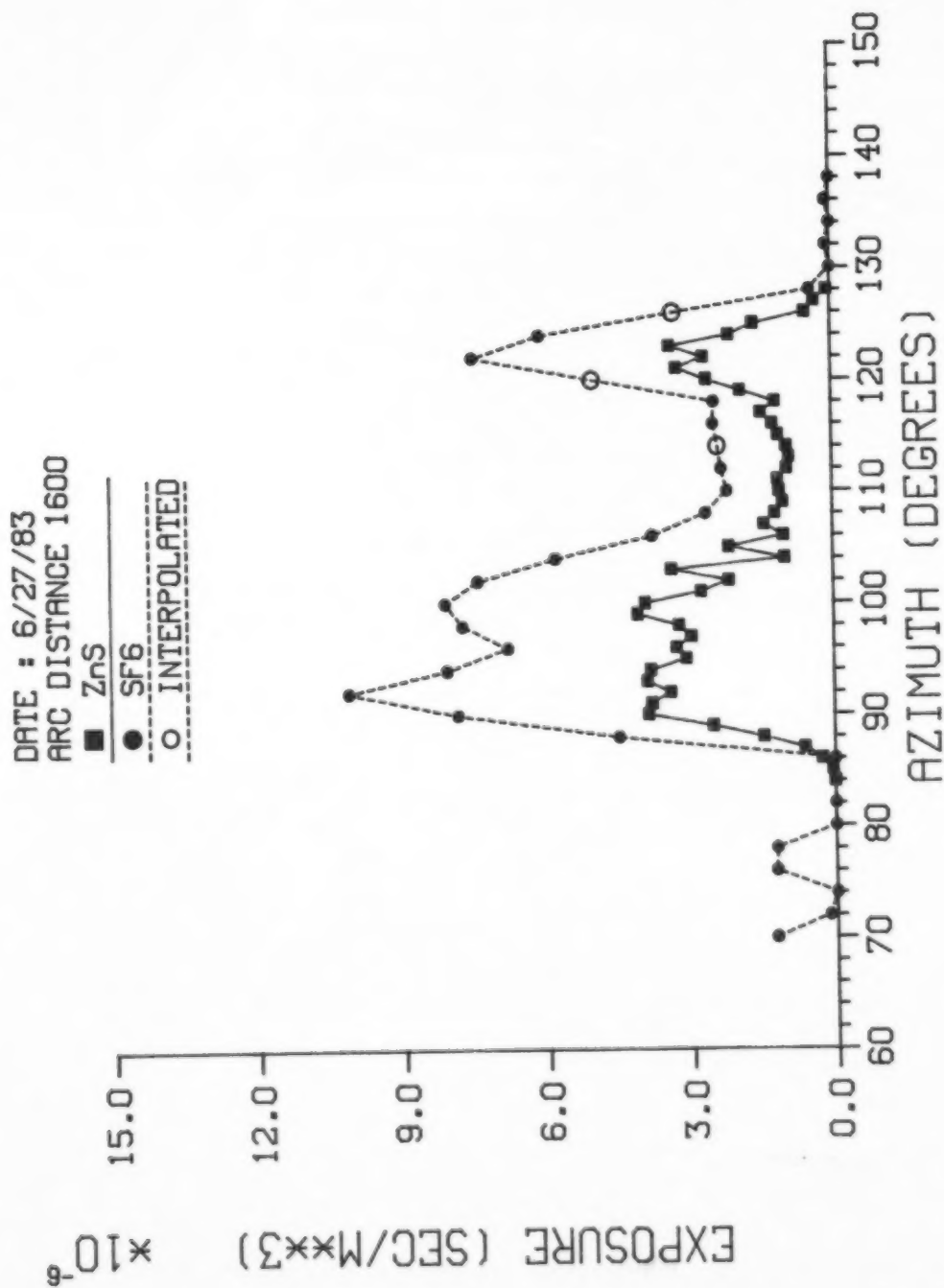


Figure C-29. Tracer concentrations at the 1600 m arc for release of June 27, 1983.

DATE : 6/27/83
 ARC DISTANCE 3200

■	ZnS
●	SF6
○	INTERPOLATED

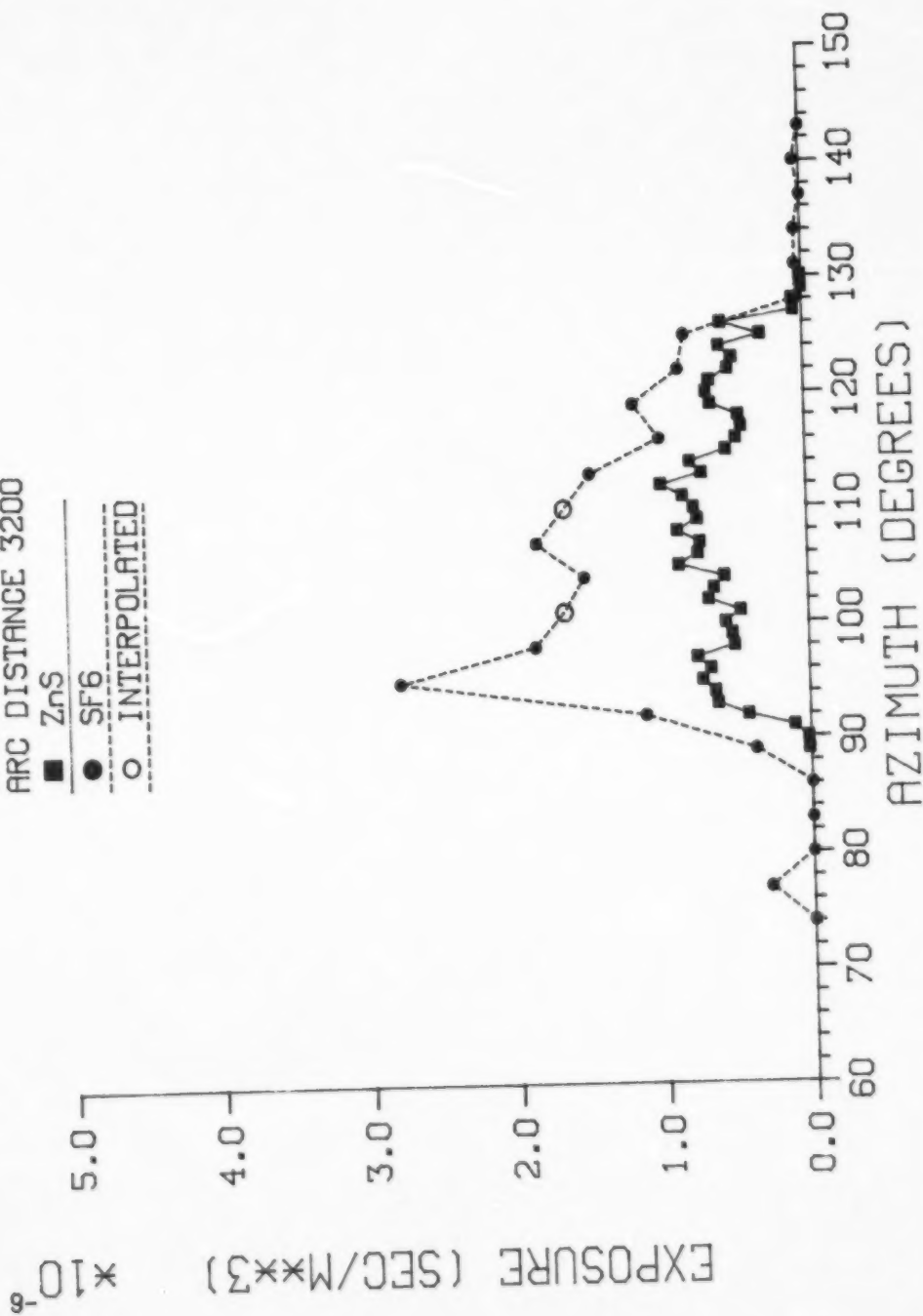


Figure C-30. Tracer concentrations at the 3200 m arc for release of June 27, 1983.